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THE ATOMIC THEORY.

One frequently hears the statement that the new ideas of matter have, or will, overthrow the atomic theory. This is true in a sense, provided, of course, the experimental evidence is sufficient to lead the scientific world to adopt the new views. Yet the statement should be modified somewhat. While the idea of an atom as an unchangeable, indestructible entity may be given up, we will still have the idea of the atom as a definite chemical unit. It makes no difference whether this unit be composed of many smaller parts or of a single particle. That particular particle or group of particles will retain its individuality, and will still be a chemical element, and the term "element" may take on a new significance.

SENSELESS INTERFERENCE WITH PUBLIC-SERVICE CORPORATIONS.

The clamor raised by a certain part of the public for public ownership of public utilities has led some individuals with political aspirations to seek, by advocating such policies, greater influence and power. Similarly, certain public officials have sought popular applause by interfering with the orderly conduct of business by the public-service corporations operating in their states or cities. A case of this kind has come up recently in the borough of Brooklyn, where the borough authorities have interfered with the extension of the electric supply by means of overhead wires, and have even gone so far as to tear down pole lines without seeking legal authority to do so. The objection raised to this extension is based on the demand that the lighting company place all of its wires underground, without respect to the district which the extension is intended to reach. From the standpoint of the city it is, of course, desirable to have all wires and pipes buried, but conduit work is most expensive and the company should not be compelled to adopt this construction unless there is the assurance that the business thereby secured will be sufficient to justify the undertaking. If the order applied only to a comparatively small district there might be some excuse for it, but where the district to be served is large, as is the case here, it is impossible for the company to put all of its wires underground; and to prohibit it from using any overhead wires is a hardship to the citizens of this district, since they will thereby be shut off from the supply. The most desirable methods of serving the public are not always available, frequently on account of the great expense that would be involved. For example, when the electric cars were first adopted for city service the city officials of nearly all the large towns demanded that a conduit system be employed; but when it was demonstrated that the method would cost too much, and that the towns would either have to put up with the old horse-cars or allow the working conductor, at least, to be above the ground, they accepted the latter alternative, and the trolley system has become the standard for city service in nearly all large towns.

Now, as regards Brooklyn, the lighting company claims that it has expended over $2,000,000 already in underground construction and that to put all the wires underground would cost $20,000,000. Not only is the company not able to undertake all of this work now, but it is physically impossible to do it all at once. The company says that it is doing the work as fast as it can, and that it should be allowed to use the overhead wires in districts which could not otherwise be served.

The situation in Brooklyn was sensibly discussed in a recent issue of the Brooklyn *Standard-Union*. This paper says that it is not an advocate of overhead wires. "They are dangerous, all of them, and the trolley wire is the most dangerous of all. They

should be put underground as speedily as may be, but no politician is justified in attempting to ruin or injure any business honestly conducted, whether by a private person or a corporation. . . . There ought to be no difficulty in adjusting on a business basis, if the matter is approached sincerely in the public interest, the proportion of underground installment that should be made each year, as the business of the company increases; but to arbitrarily say that there shall be no further extension of the service except in underground conduits would be to gravely interfere with the rights of the people as well as with the rights of the company." And what is more, the public-service corporations are anxious that their lines be safely housed in substantial conduits, but conduits form part of a permanent way and there should be evidence to justify the investment before it is forced upon them.

A NEED OF MISSIONARIES.

Liberty as to non-essentials in the mellifluous aphorism of "In essentials unity, in non-essentials liberty and in all things charity," fails to solve the difficulties which it assumes to abate, because it opens the distinctions as to which are essentials and which are outside the pale.

In countries of other beliefs the electrical engineers are met with these differences.

There are enough troubles here with aerial lines reaching from conformation with franchise exactions, and avoidance of trees, to underwriters' rules, but these are as dross in comparison to some of those in the Orient.

A telegraph line is a matter of suspicion which is increased by mistakes in the transmission resulting from the double translations from Hindoostandee or Chinese into a European language and back, but these errors are naturally attributed to the machinations of the genii of the foreign devils.

Therefore, the lines must not be fastened here or pass over there, according to the respect attaching to various shrines and points of reverence, and this goes farther to disallow that the shadow of the wire should fall upon any of the graves promiscuously peppered and salted in that densely populated land.

The telephone appears to be favored with a shade of indulgence, as they can chatter and be chattered at without any mendacity beyond that furnished by their noble selves.

The Japanese are not so distressed, but use both methods of transmission and, as is well known, have of late introduced the telephone throughout their land, and also made it a potent factor in their army evolutions.

Every Chinese boat is equipped with eyes painted at the bow, "no have eyes, how can see," but when the first locomotives were sent to China they were not, for like reason, allowed to start until a pair of eyes had been painted on the front of the boilers.

The fortunate absence of accidents furnished, of course, justification of the wisdom of this precaution.

In 1869 the American mercantile house of Russell & Company quietly laid a submarine cable from their wharf at Shanghai along the bed of the Yangtse and Woosung rivers for sixty miles, connecting their trading posts with each other and with the English cables leading to the occident.

After it had been in operation for two months it was deemed advisable to call a meeting of the native merchants and enquire if any disaster of earthquake, flood, fire or pestilence had been visited upon the town during that time.

On receiving a negative answer the merchants were informed of the cable, which was allowed to remain, although it is doubtful whether permission would have been given to lay it.

Are the Chinese alone in their different judgment as to non-essentials? Do not we also need missionaries in regard to new electric enterprises?

We may not allege that shrines to the worship of defunct ancestors will be desecrated by shadows, but whenever an electric enterprise is established, is it welcomed at its true value by those who are to be the objects of its beneficence?

When the attempt was made to supplant slow noisome horse cars by the speedy electric lines, did communities encourage the change, which would give prompt interurban transportation, relieving cities of congested tenement districts, opening up waste lands into happy homes and benefiting everyone, or was the change opposed step by step?

When the owners of electric lines are ready to place their wires underground at great expense, is the improvement a welcome one, or is it met with an opposition which is too often victorious?

A water main under a street was burst by lightning, as certain classes of water mains have been visited with like mishaps whenever in the pathway of the bolt, and an electric company was asked for damages because it had connected for certain purposes a wire, the twenty-fifth of an inch in diameter, to a water pipe in a near-by house, and this wire was not to be a part of an electrical circuit save momentarily at rare intervals, perhaps never, and any information as to its inability to conduct sufficient energy to rupture a water main fell upon unwilling ears.

We do need missionaries to raise the standard of public opinion toward those public services which are a part of modern civilization in their ministrations which are for the good of all, and yet beyond the personal resources of the most opulent individual.

An instance of the successful use of an electrically operated derrick has been shown in the building of a large Cunarder at the Dalmarnock Iron Works, Glasgow. As this was one of the largest ships that has ever been constructed and had a great height, it was necessary to arrange for exceptional derricks. Two steel derricks were constructed, each able to lift a load of five tons to a height of 120 feet from the ground level. They had a working radius of twenty-five feet from the centre of the mast. The derricks were equipped with a thirty-five-horse-power motor arranged to lift the loads at two speeds—ninety feet and 210 feet per minute, respectively—the lower speed being that at which the full load of five tons was raised.

A NEW FILAMENT LAMP.

The apparent success met in one research for some material to take the place of carbon in the filaments of incandescent lamps has stimulated others to look for similar results. The latest announcement in this matter is given in the European technical journals just at hand. The new filament has been developed by Dr. Hans Kuzel, of Baden, Austria. A number of these lamps have been made and tested, and tentative results published. These, it is claimed, show an efficiency better than that of any other incandescent lamp as yet made, including the tantalum lamp. From the data given of tests on the lamps, it seems that the efficiency for one particular lamp, for example, was at the beginning of the test 1.12 watts per Hefner candle. The consumption of energy decreased during the first 600 hours to 1.02 watts per candle, and then increased during the next 400 hours to 1.10 watts. At this point the filament burned in two, but immediately welded itself, increasing the brilliancy of the lamp, and decreasing the energy consumption per candle, which fell to 0.99 watt. From this point it gradually increased to a little over one watt per candle at about 1,450 hours, at which point it burned out finally. This lamp was for thirty-two volts, thirteen candles. The other tests show substantially the same results. In one case the lamp burned 1,500 hours before the first break, and altogether 3,500 hours, the energy consumption increasing from 1.08 watts per candle to 1.23 watts at the end of the run. During this time the candle-power decreased from 12.4 to eleven. None of the lamps was suitable for potentials over thirty-two volts. One, for a lower voltage, showed a slightly better efficiency. It is said, however, that these lamps can be manufactured for voltages up to 110. The method of manufacturing the filament is somewhat similar to that employed in preparing the carbon filaments.

It is probable that this filament is the one described in a recent English patent granted to Dr. Kuzel. The patent stated that the process may be employed for making filaments of refractable metals, such as platinum, chromium, manganese, uranium, tungsten, vanadium, tantalum, etc. The metal is reduced to a colloidal state by striking an electric arc under water. The finely divided metal thus secured is formed into filaments by pressing it through a die. The filaments are dried and are then placed in vessels which can be filled with some inert gas, and are then raised to incandescence by passing an electric current through them. This appears to crystallize the material, reducing its diameter and its specific resistance. The filaments are then ready for use.

As this method of manufacture is applicable to so many materials, it will be interesting to learn which of these gives the best results, all things considered. To determine this, the comparative difficulties of working with the different metals, as well as the cost of the metal itself and the available supply, must be considered. The improvement in efficiency claimed for the new filament is very decided and apparently the method of manufacture is not unduly expensive. At any rate, the question of improving the filament lamp is being answered.

INVENTIONS OF THE UNWISE.

No one can deny that occasionally important inventions have been made by persons not directly engaged in the industry to which their device applies, but such inventions are very rare. Generally it is the man who, working in a certain field, feels a definite need and brings forth a device to meet it.

But the haphazard inventor does not realize this. He seems to think that his ideas, which are based only on a superficial knowledge of an industry, are worth more than those of the men who have labored in it for a lifetime; and, more than this, he does not even take the trouble to find out whether some one else has not been ahead of him. He thinks that if his plan is patentable it is useful, not knowing that perhaps it has been tried previously and discarded. He proposes, for example, to apply the gas engine principle to the jet propulsion of vessels, evidently never having heard of cavitation. He devises an air propeller with overlapping vanes, not knowing that a narrow-vaned propeller is not only stronger and cheaper, but more efficient. He thinks he can construct a machine in which the action and the reaction will be in the same direction, thus doubling his force; or that, by placing a second core outside of his magnetizing coil, in addition to the one within it, that he thereby doubles his magnetizing action. If such inventors would only take the trouble to look into the subject, their time would be profitably spent, since they could thereby save many fees on worthless patents.

TELEPHONE ENGINEERING.

On the evening of Friday, February 23, at the 204th meeting of the American Institute of Electrical Engineers, Mr. John Carty, chief engineer of the New York Telephone Company, delivered a paper entitled "Telephone Engineering." The duties of the telephone engineer were discussed, and a typical case, that of the New York Telephone Company, was analyzed. As was well pointed out in the paper, and emphasized by several other speakers, the work of the telephone engineer is complex in the extreme. The innumerable ramifications of the circuit, the problems involving aerial and underground transmission of light currents at low potentials, the sensitiveness of the instruments to both proper and foreign disturbances, the traffic arrangements, and the refinements of service, which, while mechanically independent of, must be immediately coordinated with, the personal element, call for the utmost ingenuity and fidelity of purpose.

Not a little of the success of the telephone engineer is dependent upon the accuracy with which his forecasts are made regarding the future development of his system. So evolutionary is this service that the future must be discounted and in the present there must be made ready that which will be capable of handling the growth of business for a long period ahead. This calls for engineering and expenditure on a magnificent scale—and this is only worth while when there is assured permanency of appreciation and a sane understanding of the widely-varying elements which must be assembled and harmonized to make the satisfactory telephone system as it is demanded to-day.

TELEPHONE RATE PROBLEMS IN BOSTON.

BY HOWARD S. KNOWLTON.

Some unusually interesting light was thrown upon the subject of telephone rates by Mr. E. K. Hall, of the New England Telephone and Telegraph Company, at a legislative hearing held in Boston on February 16. The point at issue was House Bill No. 496, which renders it unlawful for any telephone company to demand or receive for the use of a public telephone between any two points in the city of Boston a greater sum than is charged by such a company for such use between any other two points in the city. The sponsor of the bill, Representative F. J. Gethro, pointed out that pay station charges between various parts of the city are uneven and urged the need of uniformity.

In rebuttal Attorney Hall stated that in a great and complicated industry like the telephone business it is very difficult for anyone to state with certainty that a given rate between any two points is absolutely fair, either to the company or the public. If the problem were merely one of a fair rate between the different points of a single city having but one telephone exchange, it would be easier to come somewhere near determining what rates should be applied. But in a large metropolitan community where rates are laid out with reference to the system as a whole, including branch exchanges, it is almost impossible to segregate the rates in any single district in order to determine their reasonableness.

Telephone rates in Boston and its vicinity are divided into four classes: business, residential, transient and tolls. Mr. Hall stated that it was his opinion that the long-distance or toll rates in force in New England were fair to all concerned. After the company has paid the cost of operation, maintenance, depreciation and the reasonable dividend of six per cent the surplus remaining is comparatively small. One year this surplus was found to be $60,000. The next night after the figures were made up a heavy sleet-storm came up and it cost the company $250,000 to repair the damage done by the elements. While this was an exceptionally heavy storm it wiped out the surplus, and showed what emergencies may bring forth at almost any time. The cost of repairs could not be met by issuing new stock, for the problem was plainly one of maintenance.

At the time when the city of Boston had but one exchange a single rate sufficed for the entire city, and this included all the suburbs within the ten-mile radius, except Lynn. This was done for the reason that all the suburbs of Boston within this limit constitute commercially an essential part of the metropolitan community, all being dependent on the city proper. All Boston subscribers now enjoy service between the city and all the exchanges of the city and suburban districts without extra charge, and all the suburban exchange telephones have the privilege of connection between each other without any additional expense to the subscriber. The suburban districts includes forty-two exchanges in addition to the exchanges "Main," "Back Bay," "Oxford," "Richmond," "Tremont" and "Haymarket." These last six exchanges contain at present 79,000 subscribers. Intercommunication between these carries no extra charge, and pay station rates are five cents per call.

Outside the metropolitan district the rates are graded according to the population; the highest rate is $162 per year for special unlimited service in Boston, and the lowest is $18 per year on so-called farmers' lines. The difference between business and residence rates exists largely to suit the public's convenience. The greater use of the telephone carries with it the larger rate, although in measured service one pays for just what he receives. With measured service the company has the chance to make a lower rate then is possible when only the flat rate is employed. A bank or a busy lawyer's office often prefers a flat rate, on account of the large volume of business in both directions; a doctor, on the contrary, frequently prefers measured service, for the reason that most of his traffic is inward business. In New York city there are no flat rates, all the service being measured, but in the New England field the flat rate is still quite popular.

In the last ten years the New England Telephone and Telegraph Company has made some striking reductions in its rates, and this has been purely voluntary on the part of the company. The average revenue per telephone for exchange service per year has been as follows:

	Dollars.
1896	83
1897	78
1898	73
1899	61
1900	52
1901	48
1902	44
1903	43
1904	40
1905	37

This has not all been in the way of a straight reduction of rates, but it has been accomplished by a general reduction in rates and by the introduction of lower rates for smaller users.

Long-distance rates cover any conversation over ten or fifteen miles in length, and they are based on the actual mileage. Three years ago there was a thirty-three per cent reduction in toll rates, coupled with a reduction of from five to three minutes in time. Careful records showed that ninety-five per cent of all the toll conversation in Massachusetts lasted less than three minutes. It was estimated that there would be a loss of revenue the first year about $200,000 on account of this change, but the increase of business which followed did not make the change cost as much as this.

"Short-toll" conversations cover transient business from pay stations and connections between neighboring exchanges. Six years ago the pay station rate between stations in the same city was ten cents. It was then reduced to five cents everywhere, except between the suburban exchanges and between certain exchanges in Boston proper. The reason for this was because outside the Boston and suburban district all cities and towns have but one exchange, all calls being handled on a single switchboard without trunking. Within the city limits of Boston are thirteen different exchanges. In all cases of trunking at least two switchboards, two operators and two different lines are used. In case all the direct-trunk lines between two exchanges are in use the operator must secure the connection by trunking through a third exchange. This means a large investment and operating expense. When the five-cent pay station rate was placed in effect it applied to the limits of every city and town in the suburban district, but not to Boston. Many public telephones are probably a loss to the company, especially as some sort of compensation is generally given to the owner or lessee of the premises in which the station is located. Between the six Boston exchanges closest together—in the congested district, as it were—the pay station charge is five cents per conversation. Between the seven other Boston exchanges it is ten cents, that is Brighton, Jamaica Plain, Roxbury, South Boston, Charlestown, East Boston and Dorchester are treated like the typical suburban exchanges. Mr. Hall stated that the policy of his company in freely reducing rates should be given due weight in connection with any proposed legislation, and concluded by saying that the company would doubtless reduce its rates as fast as it could without endangering the reasonable returns upon its investment.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE 204TH MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS WAS HELD IN THE AUDITORIUM OF THE NEW YORK EDISON COMPANY, 44 WEST TWENTY-SEVENTH STREET, NEW YORK CITY, FRIDAY EVENING, FEBRUARY 23, 1906.

President Wheeler called the meeting to order at 8.30 o'clock, and Secretary Pope announced that at the meeting of the board of directors, held in the afternoon, sixty-two associate members were elected and William Henry Blood, Jr., of Boston; Louis Anthyme Herdt, of Montreal; William Pestell, of Worcester, and Hiram A. Benedict, of Albany, were elected to full membership.

Mr. J. J. Carty, chief engineer of the New York Telephone Company, presented the paper of the evening, entitled, "Telephone Engineering," a portion of which appears on other pages of this issue.

Opening the discussion, Mr. Thomas D. Lockwood, of Boston, Mass., sketched briefly the early history of the Institute, and congratulated the Institute and the essayist of the evening upon the fact that this paper was such an expressive one, that it told so much, and yet there was not a single formula in it and no diagrams. To have a paper which is so clear, so extremely lucid, so perfectly instructive, and yet have no formula or diagrams in it is, in these degenerate days, a very remarkable thing indeed. When all is said and done and we have given credit and honor and glory to the man, such as he who invents the electric speaking telephone deserves, Mr. Lockwood thought there was a great deal to spare for those who have perfected the telephone business and have made it what it is to-day.

He did not think there was enough credit given to the telephone engineers who have perfected the telephone exchange as it is to-day, and, as a rule, enough credit is not given to the business men who have established the telephone business on its present footing and who, in season and out of season, through evil and good report, have put it on its feet and made it the wonderful enterprise it is to-day, and especially in these United States. In the early days one of the most remarkable things about telephone engineering was that nearly every telephone exchange throughout this country had its own telephone system, its own exchange system, its own method of switching, its own switchboard, and each system was thought by its user to be the best and there was not any other system worth looking at. Later it seemed that uniformity and standardization were desirable. Then came the stage of real engineering, and Mr. Lockwood here pointed out the very prominent part Mr. Carty had played in this development.

Mr. Lockwood said he always felt like congratulating the telephone engineer because he has had so many kinds of engineering to deal with, not merely electrical engineering, but every other kind of engineering, and this is more than hinted at in the paper of the evening, because the telephone engineer has to touch every other sort of electrical engineering somewhere.

In some respects, said Mr. Lockwood, it is fortunate that the life of the telephone switchboard is not more than fifteen years, because the rate of telephone switchboard progress is quite as fast as that, and if it did not die a natural death at the end of an average period of fifteen years it would probably have to be scrapped.

Professor M. I. Pupin stated that it was Mr. Carty who started him on the study of telephony. It was about sixteen years ago when he heard his famous paper on "Electrostatic Induction." The paper of the evening would be his catechism. Dr. Pupin said that when one considers that before long a man will be able to telephone to any part of Manhattan Island for five cents, one can not help thinking that this new art of telephone engineering is an institution which is distributing one of the greatest blessings of modern times. It is almost incredible to believe that for five cents you can talk to anyone on Manhattan Island who has a telephone. In a certain sense this new profession is a philanthropic institution; its aim is very lofty, because it is striving to establish one of the best means of keeping peace among men by maintaining a community of interest among men.

The paper of the evening, Dr. Pupin said, emphasizes one phase of the pedagogic side of engineering in connection with telephone engineering. The formation of a proper attitude of mind to look upon things from all sides in order to get the correct perspective, not specialties, because, as Mr. Carty says, the telephone engineer should have his departments; the telephone engineer makes the problems, but he does not solve them himself personally, not necessarily; if he does, it is a mere accident. He gets the problem well formed, which is really one-half the solution of it, and then he takes it to one of his departments and tries to solve it there, and if his organization can not do it he goes outside, and if he is a good telephone engineer he will not only know the men in his own department, but the men outside of his department who would be likely to be capable of handling a certain problem which he has formulated in the course of his engineering work.

Mr. C. P. Steinmetz desired to draw attention to one feature of the paper. Telephony has always appeared to him a very fascinating matter. To consider how sound can be transmitted over long distances by currents so minute that only with the most sensitive oscillograph has it been possible to record them on the photographic film. There is, however, one very important and instructive feature in telephone transmission for the consideration not only of the telephone engineer, but the electrical engineer in general—both the transmission of power and the transmission of speech are essentially electrical transmissions of power. There is, however, an entirely different purpose involved, and therefore different methods and different results. In electric power transmission the problem is to deliver at the end of the line as large a percentage as possible of the power which has been sent into the transmission line. In telephone transmission this is not the problem, but the problem is to deliver at the end of the line the electric power with a relative proportion as nearly the same as the relative proportion of the harmonics of the complex wave sent into the line by the telephone. Herein consists the great difficulty of long-distance telephone transmission. If it were only the question of delivering power to operate the telephone over the telephone line, it would be a very easy problem. The telephone is such a sensitive apparatus that we could easily transmit from San Francisco to New York enough power, and even throw in a trans-Atlantic cable and still get enough power to operate a telephone from San Francisco to New York and London; that is, to hear a sound, but not to understand. You could transmit sound, but you could not transmit articulation; that is, those higher harmonics of the current wave which constitute the difference between the different sounds of the different letters. To transmit the electric power of the electric current so as to destroy this articulation as little as possible—that is, to retain as far as possible the relative proportions of the different components of the complex current wave which the telephone or micaphone sends into the line—is the problem of telephony, but the question of efficiency does not come into consideration; the question of power delivered is immaterial, because the

amount of power is negligible; it is with the question of eliminating destruction or deterioration of the wave that the telephone has to deal.

Mr. B. Gherardi, Brooklyn, N. Y., contributed the following discussion, which, owing to the lateness of the hour, was not read: There is one phase of telephone engineering which Mr. Carty has necessarily only touched upon briefly. This is the engineering which, as a matter of administrative efficiency, should be done in the various executive departments of the organization. The most conspicuous examples of these are the engineering which must be done in the department under the control of the superintendent of traffic, and in the department under the control of the superintendent of construction. The engineering done in the traffic department is in charge of an engineer usually designated as the traffic engineer, who has reporting to him a sufficient number of assistants to do the required work. This engineer is charged with responsibility for a large amount of work, which, while essentially engineering in its character, is nevertheless so closely related to the detail methods of operation in use in the traffic department and the detail administration of that department, that to have it done in the office of the chief engineer of the company would require that the chief engineer should keep complete records in detail of matters going on in the traffic department and be familiar to the last detail with a vast number of administrative questions concerning that department.

One of the functions of the traffic engineer is to watch carefully the growth of the business with reference to the requirements for additional equipment of all kinds for switchboards and a proper length of time in advance to make a report stating that additional equipment is required and recommending the extent of such equipment. As giving an idea of the complexity of this function alone, I might say that the following are some of the factors which the traffic engineer has to watch in connection with each large switchboard in the system:

The number of subscribers' lines available in the multiple.

The number of switchboard positions available for subscribers' operators.

The number of switchboard positions available for trunk operators of various classes.

The number of incoming trunk cords available for incoming trunk lines of various classes.

The number of call-wire circuits available for calling circuits.

The arrangement of answering jacks, so that it may be possible to give all operators at the switchboard proper loads.

In addition to these items in the switchboard itself there are all of the various items concerning the information desk, the assistant manager's desk and the manager's desk—elements of the plant which are of the utmost importance in connection with an efficient operation of the system as a whole.

The report recommending additional switchboard equipment is made to the superintendent of traffic, and if approved by him is transmitted to the chief engineer. The report, if in proper form, gives the essential facts upon which the recommendation is based and enables the chief engineer to pass promptly on the matter. As will be seen by this routine, the chief engineer does not necessarily have to concern himself with the detail affairs of the traffic department, while at the same time he is not relieved of the responsibility in regard to the amount and character of plant provided.

Another very important function of the traffic engineer is to watch the constant growth of the business trunked between various offices and handled over toll lines between various sections of the territory. It is his duty to originate recommendations for additional trunk circuits that may be required to take care of this business. These recommendations, when requiring additional plant, are in due course transmitted to the chief engineer with a request that a formal estimate be prepared and an appropriation asked for. Thus the matter comes before the chief engineer, and again, as in the case of the switchboard equipment, the final responsibility is with him.

Numerous cases arise in which it is necessary that detail studies should be made of various operating methods. These studies can best be made by some one forming part of the traffic department, and it is in general the traffic engineer's duty to do such work. The results of these studies, when they indicate any important change in the operating methods of the company, are submitted to the chief engineer with the facts in the case, and he in this way passes upon the matter.

In the construction department there is necessity for a construction engineer, who performs, with reference to that department, functions similar in their general nature to those performed by the traffic engineer in the traffic department. One of the very important functions of this construction engineer is to keep constant watch of the cable situation and to recommend a sufficient length of time in advance additional cables or extensions of cables to take care of the business. These recommendations are made by him to the superintendent of construction and by him transmitted to the chief engineer with a request for estimate. Upon being received by the chief engineer they are checked up, and thus again the responsibility is finally with him.

In cases such as this, where the administration of the construction department and its engineering work are efficient, the principal work of the chief engineer in connection with such cases is to see that the plans proposed fit in with the general studies and general scheme of development. He also sees that the plans provide for the use of standard materials or materials appropriate to the particular situation in question.

An important function of the construction engineer is with reference to the rights of way necessary to carry out contemplated pole-line construction. Such rights of way are so intimately associated with the final planning of the construction that they must be obtained prior to the preparing of actual plans of the work. At the same time the rights can not be obtained without careful engineering consideration as to what such plans should be. Hence it has been found that in a large company the rights of way had best be handled by the construction engineer, and the right-of-way work is a very important part of his duties.

From an engineering standpoint I think it is safe to characterize the development of an organization having engineers in the construction and the traffic departments as one of the important steps which lead to efficiency of the operating organization as a whole.

Indiana Telephone Companies Organize.

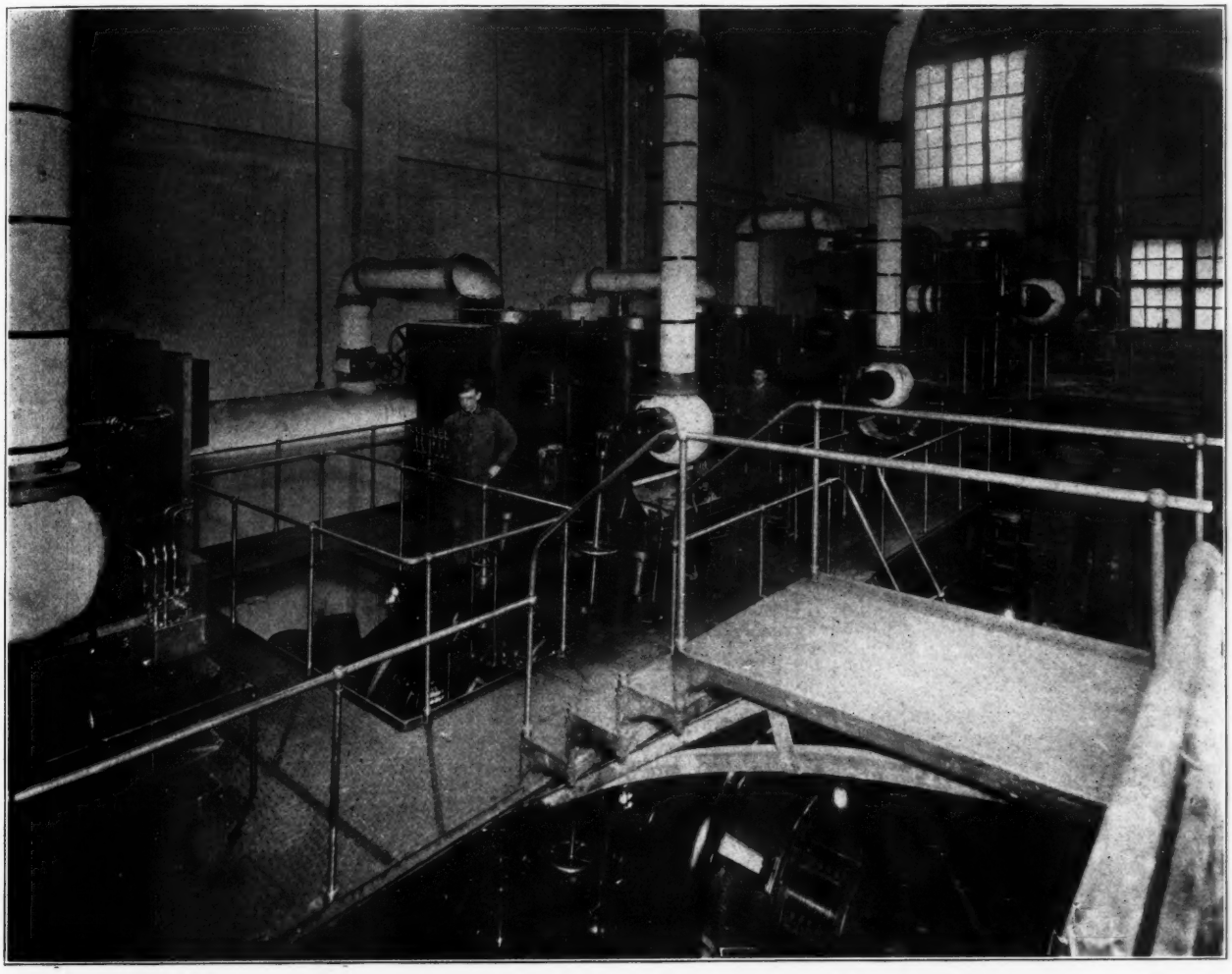
The independent telephone companies of Boone county, Indiana, have organized the Protective Telephone Association, with headquarters at Lebanon, Ind. P. B. Little, of Whitestown, has been elected president; B. F. Stoner, New Brunswick, vice-president, and George Lyster, Thornton, secretary and treasurer. The purposes of the association are to devise plans for mutual protection and to improve the telephone service throughout the county.

The Power Plant for the New Wanamaker Store, Philadelphia, Pa.

THE new Wanamaker store, when completed, will cover two city blocks, extending from South Juniper street to South Thirteenth street, and from Market street to Chestnut street, Philadelphia, Pa. At present a quarter section of the new building has been erected on the corner abutting on Market and South Juniper streets. This building is twelve stories high, and covers a ground area of 120,301 square feet. The plant as much as possible, and the task which the architects have solved in so highly advantageous a manner was to install the largest isolated plant in the country to-day on a plot of ground about sixty-five feet by ninety feet square.

By a very symmetrical grouping of the apparatus in straight lines along the length of the building, and leaving free room in between for piping and auxiliaries, it has been possible to eliminate double-decking, room are located the boiler auxiliaries; on the floor above, the boiler room; above this floor, the coal hoppers, and on the top floor the refrigerating apparatus and a large space for workshop facilities.

The refrigerating apparatus will be of the absorption type, exhaust steam being used for heating, and electrical pumps for the ammonia machines and for circulating the brine. Refrigeration will be an important factor in the big restaurant



VIEW IN THE ENGINE ROOM OF THE POWER PLANT FOR THE WANAMAKER BUILDING, PHILADELPHIA, PA.

section of the old store between the new building and South Juniper street is now being torn down, leaving the half section facing on Chestnut street intact.

The power plant is about half a block away on Ludlow street, which ends at South Thirteenth street opposite the store building. The two buildings are connected by a tunnel, which will be described further on. Owing to the very great value of property at this point, it was decided to restrict the ground area for the power and while the equipment is necessarily placed at different floor levels, the arrangement is such that attendance will be reduced to a minimum. The heavy elevator pumps and power pumps have been placed in a sub-basement along the west side of the building, the engine foundation being placed along the east side, the running board of the larger engines coming flush with the lower of two mezzanine floors opening from the engine room. Above the engine for preserving produce and for ice-water throughout the store building, as well as for cold storage of furs and other stock.

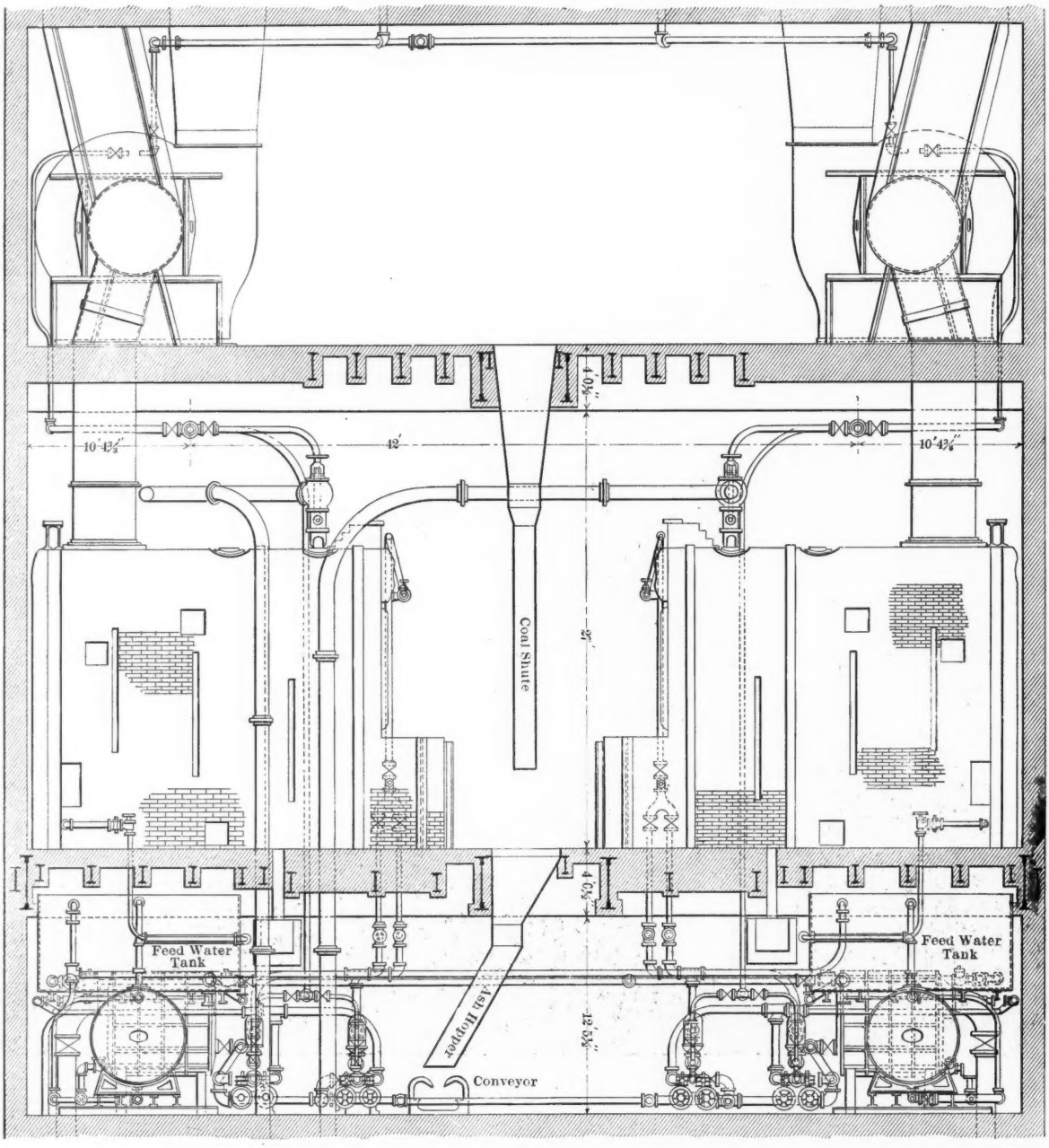
The boiler equipment consists of eight Babcock & Wilcox boilers, each boiler having 294 tubes four inches in diameter and eighteen feet long, arranged in nests of seven tubes wide and fourteen tubes high, under three steam drums thirty-six inches in diameter and twenty-one feet six and one-half inches long. The boilers are built to carry 200 pounds, the working

pressure of this installation running at 140 pounds.

In addition to natural draught, the boilers are equipped with induced draught fans in the stacks and forced draught blowers in the furnaces. As far as the induced draught and forced draught are concerned the boilers are operated in pairs, one draught equipment serving two boilers. The boilers are arranged four on each side of the building, and one flue serves a pair of boilers. The boiler stacks are arranged so that the flue for the natural draught runs into the upright blower stack at an angle, the induced draught being given as much facility as possible. Where the two stacks join they are enclosed in a brick chamber insulated from the rest of the large room on the top floor of the power-house by ample air space behind the enclosing walls. The four induced draught fans were built by the American Blower Company, Detroit, Mich., and are each 180 inches in diameter, driven by direct-connected vertical engines. They each have a capacity for handling 51,000 cubic feet of gas per minute and at normal speed will produce one and one-half inches draught water gauge when running 250 feet per minute and two-inch draught water gauge when running 288 revolutions per minute.

The four forced-draught fans were also built by the American Blower Company, are each 110 inches, full housed, with a capacity of 27,000 cubic feet per minute against a total pressure of one and one-quarter ounces when running at 385 revolutions per minute. They are operated by General Electric motors and Cutler-Hammer speed regulators.

The boiler furnaces are served by coal chutes regulated by gates and hand-chains, the coal being delivered to the front of the fires as needed. Coal is taken directly from the hoppers above, a link belt conveyer carrying the coal from below the street level, elevating it and distributing

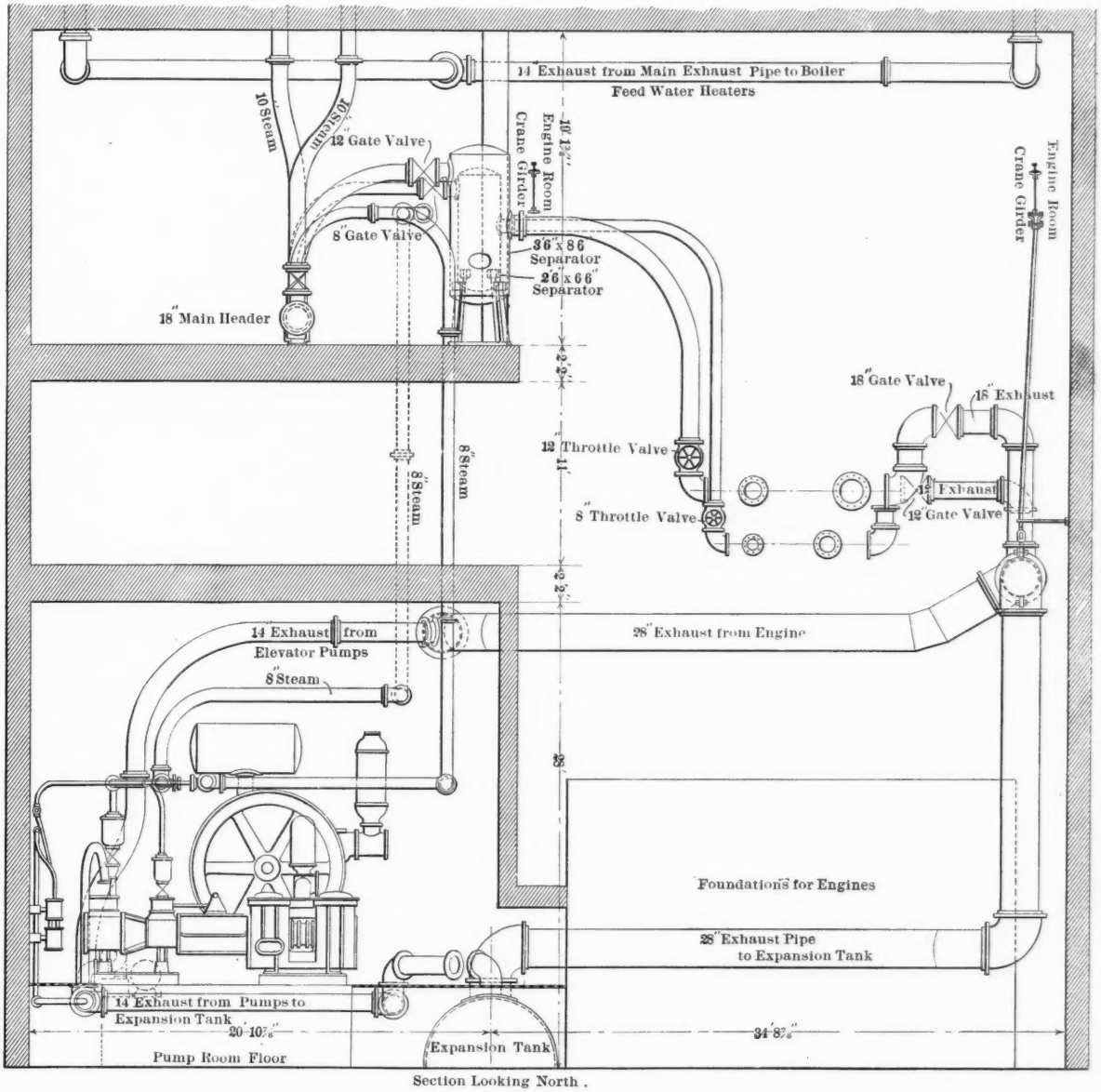


End Elevation, Looking North. Boiler Auxiliary Room, Boiler Room, Coal Bins, with Refrigerating Room Above, Power-House for the Wanamaker Building, Philadelphia, Pa.

it automatically to the bin. This bin runs nearly the whole length of the building. Adjacent to the coal bin, and near the south end of the building, is a smaller ash bin. The ashes are delivered through chutes to the conveyer, which has a horizontal run along the boiler auxiliary floor. As the buckets pass the ash pit the automatic tripper deposits the ashes in the ash bin. From the ash bin the ashes are chuted down to a gate-controlled funnel, which delivers them to carts in the street.

The three drums of each boiler feed through ten-inch check valves into a ten-inch steam line. Each set of boilers also delivers steam through a four-inch main to an eight-inch auxiliary pipe-line, from which is taken off high-pressure steam for the boiler feed pumps, for the induced draught engines, for two three-inch lines for the generators of the absorption system, for a six-inch line to the expansion tank, and for an eight-inch live-steam line to the store building. Four-inch hot and cold feed-water lines run in loops along the front of the boilers. All high-pressure drips above the boilers are allowed to flow through wide-open valves by gravity back to the boilers. Drips below the boilers flow directly without the use of traps to a pump and receiver in the basement and from there pumped back to the boilers.

Directly below the boiler room is the boiler auxiliary room. The auxiliary apparatus includes four Knowles outside-end packed, plunger pot-valve pattern, fourteen-inch by eight and one-half-inch by twelve-inch high-duty pumps, each having a capacity of 69,000 pounds of hot water per hour; four Warren Webster & Company (Camden, N. J.) feed-water heaters and purifiers and two large blow-off tanks. Suspended from the ceiling of the boiler auxiliary room are two feed-water tanks, each of 6,000 gallons capacity. City water is used, the water being delivered to a large tank in the sub-basement and elevated by motor-driven centrifugal pumps to the feed-water tanks. The returns from the heating system are also delivered to this tank. From the feed-water tanks the water flows by gravity to the heaters, and from the heaters to the suction of the feed-water pumps



Section Looking North.

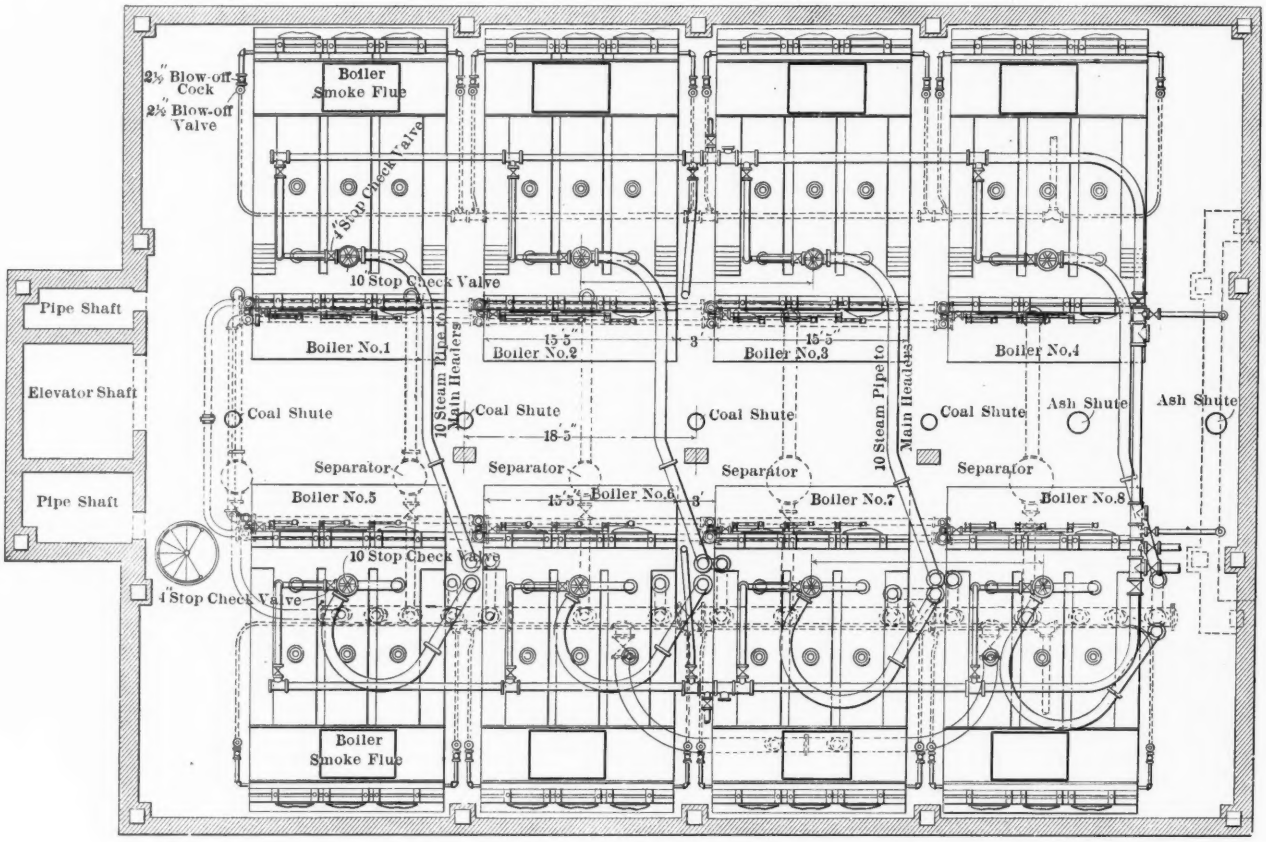
END ELEVATION, LOOKING NORTH. SUBBASEMENT, ENGINE ROOM, AND FIRST AND SECOND MEZZANINE FLOORS. POWER-HOUSE FOR THE WANAMAKER BUILDING, PHILADELPHIA, PA.

which deliver the hot water directly to the boilers. The four feed-water pumps deliver the water through two lines of piping so arranged that any one of the four pumps can be run on either of the two lines, or all four of the pumps can deliver hot water to a single line. These boiler feed pumps can also be used as emergency house fire-pumps, and for filling the boilers, or in case of fire water can be taken directly from the bottom of the tanks without passing through the heaters. The two blow-off tanks are fed by two six-inch lines, which receive the blow-off from the two and one-half-inch lines from the boilers.

this arrangement is seen immediately by the facility with which all throttles and gate valves can be reached from the floor level. The main header is without flanges, except where the steam lines make connection with the header. These connections are made with steel necks riveted to the header.

One of the mechanical features of this installation is the use of long and graceful sweeps of piping, eliminating angles and abrupt changes of direction in the piping. The piping is hung on spring hangers, allowing for expansion and contraction. All piping is covered with eighty-five per cent magnesia, canvas-

inch and eight-inch lines are led to the engine throttles. The main header is split by motor-driven valves into three sections, with a by-pass connecting the two outside sections. The motor-driven valves are so arranged that they can be worked either at the valve or from the switchboard gallery. Each end of the by-pass is equipped with a gate valve. At both ends of the header an eight-inch line is taken off, passing through the building to the elevator pumps in the sub-basement. These lines unite to form a loop, which includes the four elevator pumps; and in case there should be trouble with one end of the steam line, the faulty point can be



Plan of the Boiler Room. Power Plant for the Wanamaker Building, Philadelphia, Pa.

On the floor with the boiler auxiliaries are located four 110-inch American Blower Company's fans, driven by forty-horse-power General Electric motors at 915 revolutions per minute. These motors are controlled by Cutler-Hammer starting boxes and speed controllers, permitting a reduction in speed of fifty per cent. The fans deliver air to air ducts for forced draught, each fan equipment serving a pair of boilers.

An eighteen-inch lap-welded sheet-steel main header rests upon saddles on the second mezzanine floor. The utility of

jacketed, bound with Russia iron bands, and given two coats of anti-flame paint. All water pipes are covered with felt, and the hot-water pipes are covered with felt with asbestos lining. All suspended sewers in the building are covered with felt. The ten-inch mains from the eight boilers pass through the boiler auxiliary room and feed into the main header. From this main header two twelve-inch lines are taken to forty-two-inch separators for the large engines, and three eight-inch lines to thirty-inch separators for the smaller engines. From the separators twelve-

isolated and steam taken from the other side.

On the second mezzanine floor there is also located a small air-compressor plant, consisting of two Clayton air compressors driven by seven and one-half-horse-power Crocker-Wheeler motors. There is a Cutler-Hammer automatic starter and speed controller which regulates the pressure, so that when the tank is full the motors are automatically slowed down, and at the proper time cut out of service. When the pressure in the tank has fallen to a predetermined point, the motors are au-

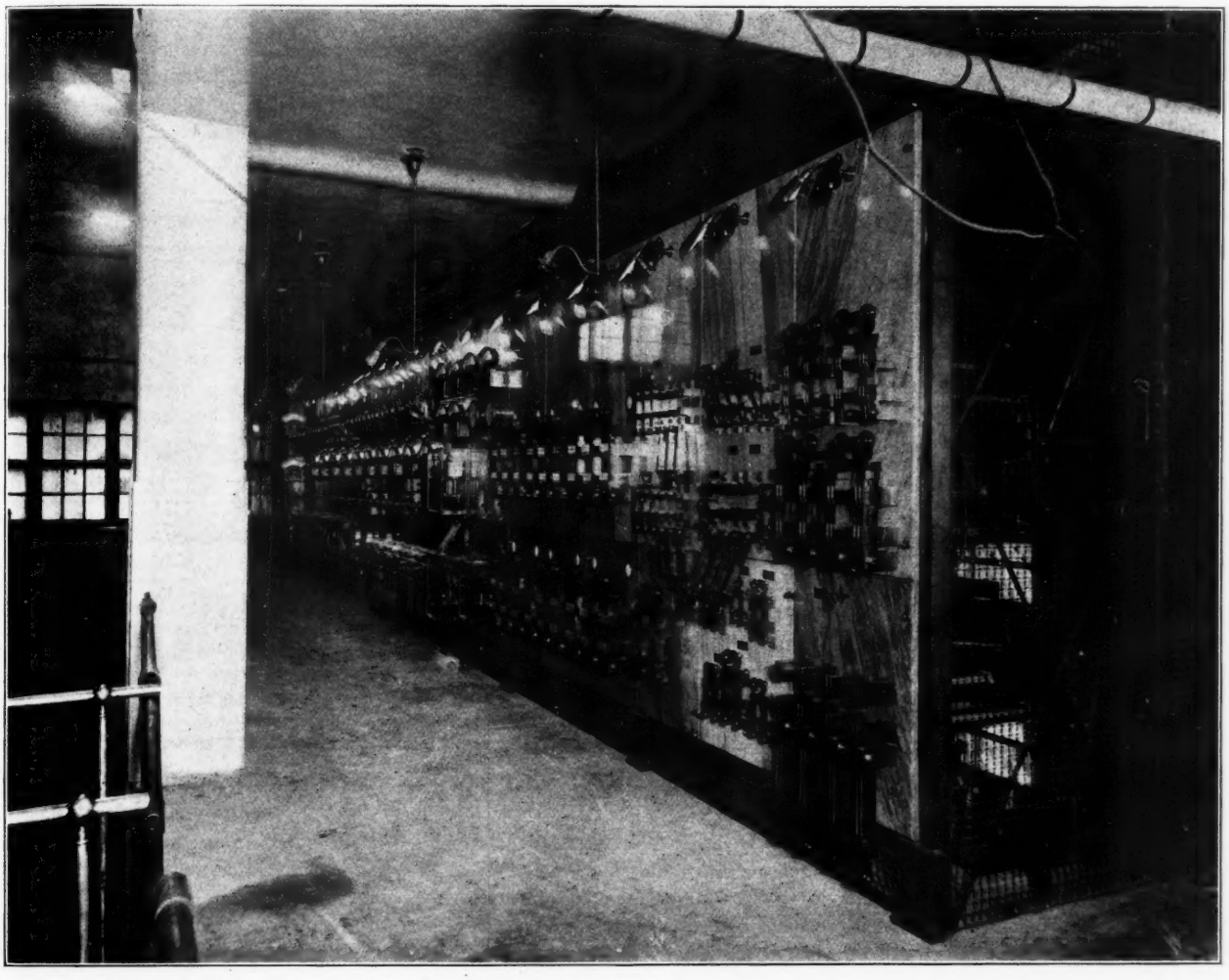
tomatically cut into service. The compressed air is used for cleaning purposes and for handling oil for the lubricating system of the engines.

Adjacent to the air-compressor system is an oil tank supported upon an angle-iron framework. The lubricating oil flows by gravity through this tank to the five engines, all of the bearings being served. After passing through the engines the oil drains into the flywheel pits. From the pits the oil flows by gravity to filters and from the filters to a receiving tank in the basement pump room. The compressed-air service then forces the oil back to the supply tank on the second mezzanine floor.

The five engines were built by the Southwark Foundry and Machine Company, Philadelphia, Pa., and are of a special cross-compound vertical type for isolated plant service. The two larger engines develop about 1,500 horse-power each and are equipped with a 500-kilowatt compound-wound Crocker-Wheeler generator upon each end of the shaft, the flywheel being in the middle of the engine. The three smaller engines develop about 500 horse-power each and are equipped with 175-kilowatt compound-wound Crocker-Wheeler generators, one on each end of the shaft. The normal electrical capacity is thus 3,050 kilowatts. The engine room is served by a ten-ton motor-driven crane built by Alfred Box, Philadelphia, Pa.

The exhaust from the engines is delivered to a twenty-eight-inch main, one end of which passes through the wall to a vertical atmospheric exhaust. The other end goes to an expansion tank thirty-one feet long and nine feet in diameter, which is located in the basement. From the expansion tank four eighteen-inch lines deliver exhaust steam to the heating system of the main store building. A back-pressure valve in the atmospheric exhaust works automatically and regulates the pressure of the heating system. From the twenty-eight-inch exhaust a fourteen-inch auxiliary is taken for the boiler feed-water heaters.

All lighting in the power-house and in the store building is on the three-wire system, 220 volts being the drop between the outside lines. A deep trench is arranged in the engine foundation to accommodate a slate panelboard, upon which the lugs for receiving the flexible cables from the generators are mounted. From these panelboards the current is delivered to the switchboard bus-bars through flat copper bars six inches wide and five-sixteenths of an inch thick. Each conductor for the 500-kilowatt generators consists of four bare copper bars sweated into a lug which is bolted to the ends of fuse clips. The bare copper bars are supported on insulators throughout the trench and are carried behind a sheet-steel shield to the ceiling of the basement. Along the ceiling of the basement the bars are protected by a similar sheet-steel shield, the bars passing through the ceiling to the switchboard, which is located on the first mezzanine floor. On their way from the trench to the switchboard the bars are insulated by heavy porcelain bushings, which are mortised so as to provide ample



SWITCHBOARD, FIRST MEZZANINE FLOOR. POWER PLANT FOR THE WANAMAKER BUILDING, PHILADELPHIA, PA.

air space for dielectric insulation and cooling.

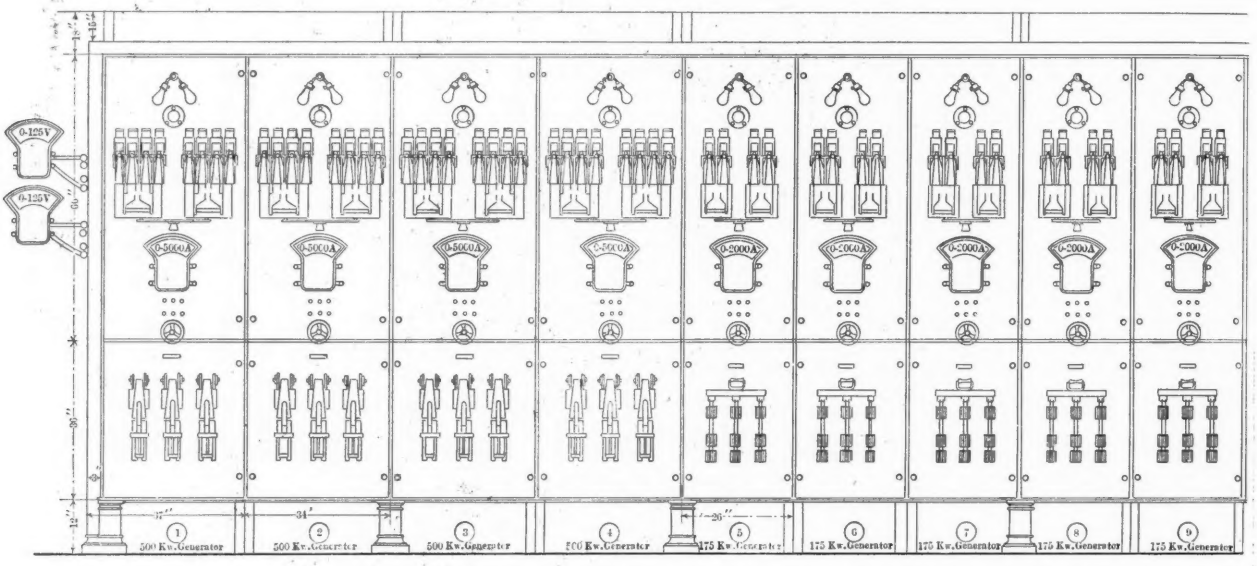
The switchboard was furnished by J. F. Buchanan & Co., of Philadelphia, the electrical contractor, and built by the H. O. S. Engineering Company, of Newark, N. J. This is probably the largest and most completely equipped switchboard which has been installed in an isolated power plant. The board is forty-seven feet wide and eleven feet high, built of polished marble mounted on substantial angle-iron frames and ornamental bronze supporting pedestals. The top of the board is ornamented with a handsome bronze grill work and the rear is protected by an expanded metal cage. The board faces the engine room and is composed of eighteen panels. Facing the board, and reading from the left to the right, these are as follows: four panels for the 500-kilowatt generators, six panels for the 175-kilowatt generators, one lighting totalizing panel, one power totalizing panel, three panels for the lighting mains for the store distribution, two panels for the power-house lights and the total power in the power-house, and one panel for the power-house mains for store distribution. The power-house mains and, in fact, all power are on the two-wire system, 220 volts.

Each of the generator panels is equipped with pilot lights, ammeters, circuit-breakers, and for the 5,000-ampere circuits of the 500-kilowatt generators a special form of toggle lever interlocking switch, made by the General Electric Company, is used. The totalizing panels are equipped with Weston ammeters and voltmeters, a Bristol recording gauge, special indicator handles for taking the voltage on any of the circuits and Thomson recording wattmeters. The lighting panels are equipped with pilot lamps tapped in on the proper circuits. The power panels are equipped with the usual switches, a very good idea of the arrangement being given in the accompanying illustration.

From the switchboard lead-covered cables are taken to the south end of the building, passing through a conduit to a manhole. From this manhole the feeders pass through a forty-nine-duct conduit built just above the top of the tunnel. The feeders from the switchboard consist of the following: thirty-one 2,000,000-circular-mil cables for lighting, six 2,000,000-circular-mil cables for power and two 1,500,000-circular-mil cables for power. These feeders are all of stranded copper, rubber and lead-covered.

In the sub-basement, in addition to the expansion tank and the water supply tank, are located the four elevator pumps, built by the Laidlaw-Dunn-Gordon Company, two deep-well pumps, the bilge pumps and four Westinghouse steam-driven air-compressors. The overflow tank for the elevator pumps is on the first mezzanine floor, facing the engine room. The sub-basement is also served by a ten-ton traveling crane built by Alfred Box, Philadelphia.

The boiler room and the engine room of this installation are served by arc and incandescent lights; and every possible means has been taken to secure sanitary conditions, both as regards lighting and ventilation, and the comfort of the employés. Finely equipped toilet rooms are provided, the ordinary facilities being supplemented with shower baths, the rooms being entirely fitted up in marble. The engineer's office, which is adjacent to the switchboard on the first mezzanine floor, contains a handsome marble panelboard, upon which are placed an Edson recording and alarm steam gauge, a boiler pressure gauge, a steam-heating gauge for pressure and vacuum, an elevator gauge showing the pressure of water, a water gauge showing the pounds of water and the height of the water in feet, a compound gauge showing the pressure or vacuum on heating system, and a recording gauge giving a record of the pressure and vacuum on the same system, a draught gauge measuring the draught in inches on all four stacks and an E. Howard & Company ship chronometer clock.



Arrangement of Apparatus. Switchboard in the Power Plant for the Wanamaker Building, Philadelphia, Pa.

The power tunnel is built with a steel frame with brick walls, concrete arched roof and concrete floor. The tunnel is twelve feet wide, eight feet high and its length at the present time is 175 feet. The service pipes are carried on brackets on roller bearings, allowing for expansion and contraction. The tunnel houses two twenty-two-inch supply pipes for the elevators and two twenty-two-inch return pipes, four eighteen-inch steam-heating supply pipes, one eight-inch high-pressure steam pipe, one eight-inch return from the condensation pump, two six-inch house tank supply pipes, two six-inch brine pipes, two four-inch ice water pipes, one three-inch cold water supply, one two and one-half-inch hot water supply and one one and one-half-inch hot water return. As mentioned before, the conduit for the feeders is laid above the top of the tunnel, about eight-

een inches below the surface of the street. At the present time these cables are taken from a manhole at the store building end of the tunnel and carried around the Market street end to the new building.

The new building is built in three sections—the north section, the south section and the middle section. The north and south sections are separated from the middle section by fire walls. At four points on each of these fire walls cabinets are erected on the different floors, taking the leads from the wire shafts. Each section of the new building contains a main switchboard in the basement. From this main switchboard the circuits are controlled for the different floors of the building. All circuits are carried in iron conduit through the wire shafts, and from Wire shafts have been established with the outlet boxes all connected up, so that all that is necessary is to determine the location of the instrument and make the proper connections.

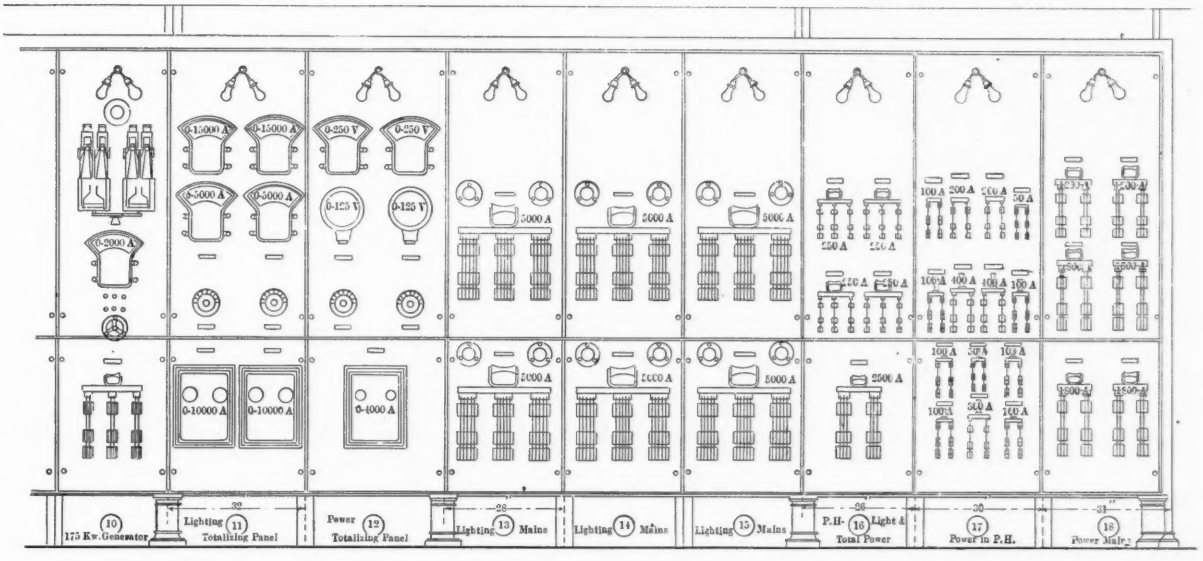
The architects and engineers for the whole work of the power-house and new store building are D. H. Burnham & Company, Chicago, Ill.; Mr. C. M. Wilkes (deceased), chief engineer. Mr. P. G. Chace has been responsible for the execution of the work and Mr. H. A. Eckman has been chief assistant as superintendent of construction. It is to these gentlemen that we are indebted for the data given in this article.

Smoke and Smoke Prevention.

An interesting symposium on the subject of smoke and smoke prevention was given by the New York section of the Society of Chemical Industry at the Chemists' Club, 108 West Fifty-fifth street, New York city, on the evening of February 23. The first speaker was the Hon. Thomas Darlington, health commissioner of New York city, who explained the status of smoke regulation as it exists in this country. Regulation may be attempted either by a state law or a municipal ordinance. At the present time there are but two instances in which the state has attempted to control the matter. The first was for the city of Brooklyn in 1895. Under it a number of flagrant nuisances were abated, but in one case the matter was carried to court and decided against the state on the ground that the law was unconstitutional. The state did not deem it advisable to carry the matter further. The second instance is in Massachusetts, where a state law was passed in 1905 for controlling the production of smoke in the city of Boston. This prohibits the giving off of dark or dense gray smoke for a period of more than six minutes, and defines the means of determining whether the smoke violates the law or not.

A number of cities have attempted to regulate the matter by municipal ordinances. Among these are Cleveland, Cincinnati, Philadelphia and New York. Philadelphia employs a dark glass scale for determining the density of the smoke. The law does not apply to those industries where furnaces are employed for working iron, nor is it applicable during the early hours of the morning. In New York the matter may be attacked from either of two standpoints: either under the penal code for maintaining a nuisance dangerous to the health and life of the community, or under the sanitary code through a specific law. The difficulty in the first case is to show that smoke is a menace to the health of the community. Under the second it must be shown that a nuisance exists—that is to say, that the trouble and inconvenience to which objection is raised are produced by the smoke coming from that particular chimney against which the complaint is made. This is exceedingly difficult. The board of health of the city of New York has very arbitrary powers, and for this reason must exercise them with the greatest care; it does not seem justifiable that it should use these extraordinary powers for abating a nuisance. However, during the past year it has succeeded in correcting 180 of the minor cases.

Mr. Adam De Trampe spoke briefly of



ARRANGEMENT OF APPARATUS. SWITCHBOARD IN THE POWER PLANT FOR THE WANAMAKER BUILDING, PHILADELPHIA, PA.

the cutout cabinets are and incandescent circuits are taken off for the general distribution. The load on the lighting mains includes incandescent lamps at 110 volts, arc lamps at 110 volts, electric dumbwaiters and escalators at 220 volts, and electric fans and the electrically driven power-house apparatus described above.

There are fifty-two passenger elevators, two large freight and van elevators, eight ordinary freight elevators, six sidewalk lifts in the store, one freight elevator in the power-house—all of the hydraulic plunger type. In addition to this there are ten electric dumbwaiters. A feature of the wiring installation is the complete conduit system for bell and telephone work. Arrangements have been made so that it will not be necessary to rewire any part of the structure when equipping the present building with call-bells and telephones.

the use of soft coal under boilers. In the city of New York during the past year 15,500,000 tons of coal had been burned, a considerable amount of which was bituminous coal. On the assumption that 1.5 per cent of all of this coal had been set free as smoke, about 230,000 tons of soot would be liberated in the city during the year, equivalent to 600 tons of lamp-black per day. The speaker thought that eventually the use of coal in cities would be discontinued and fluid fuels employed, or possibly electrical energy transmitted to the city from an outside point.

Mr. Leonard H. White explained the theory of down-draught furnaces, and described a new type of furnace in which the distortion of grates due to the intense heat of the flames forced through them in the ordinary down-draught furnace was avoided. In this furnace a sloping chamber or fire pot is arranged, fed from the outside and supplied with air either by forced or induced draught through the same opening. The fire is at the inner part of this, and as it burns away the fuel there the other slides down. The gases distilled from the green coal pass through the incandescent bed of fuel and are consumed. Just beyond the firebox is a large combustion chamber lined with fire-brick, where the combustion is completed. A furnace of this type has a comparatively low capacity, but since the inner part of the fuel is coked and can be burned on an ordinary grate, this furnace may be combined with a grate furnace, the green fuel being fed in at two points, where it is coked by the down-draught process and the incandescent coke passing inward over a grate, where it is burned in the ordinary way.

Mr. Walker Bowman described a device for filtering smoke, which had been tested recently in Milwaukee. It consists of a drum, which may be revolved slowly about its axis. Tubes are arranged in rows along the outer surface. These are covered with bags of cloth for filtering cold gases, or, for filtering smoke, with asbestos bags. The particular test, he reported, had not been entirely successful, for the filtering bags clogged up after a few hours' run and stopped the passage of gases. Moreover, a brown deposit took place in the room, apparently due to tarry substances which pass through the filter.

Mr. Ernest H. Foster described a method of building smokeless furnaces, which has been devised and patented by Dean William Kent, of Syracuse University. The main feature of this furnace is a pair of wing walls arranged within the combustion chamber so as to give a narrow vertical opening. In front of the boiler setting is placed the grate in a properly lined furnace having a bridge wall of the ordinary type. The gases pass over this wall in a horizontal layer, and when they strike the wing walls their direction is changed and the hotter and cooler portions are thoroughly mixed, and complete combustion results. By applying this method of construction, savings of from ten to fifteen per cent of the fuel have been effected and the production of smoke entirely avoided.

Mr. A. A. Cary spoke of the proper method of building furnaces so as to prevent smoke and of the proper way of firing the furnace. He thought that something might be accomplished by licensing firemen.

During the discussion which followed, the relative values of oils and coal were mentioned. The following were given as the figures determined by the Standard Oil Company: oil at twenty cents a barrel is equivalent to coal at sixty-five cents a ton; at forty cents a barrel, to coal at $1.49 a ton; at $1 a barrel and $2 a barrel, to coal at $3.26 and $6.52, respectively.

A Testimonial Dinner to George H. Daniels.

On the evening of Tuesday, February 20, a testimonial dinner was tendered to Mr. George H. Daniels, general manager of the advertising bureau of the New York Central lines. The dinner was arranged by a number of prominent New York newspaper men and advertising managers, and was participated in by about 500 representatives of daily newspapers, magazine publishers, technical journals, trade papers and railroad managers. The toastmaster of the evening was William H. McElroy, LL.D., and responses were made by Frank R. Lawrence, president of the Lotos Club; Admiral Joseph B. Coghlan, U. S. N.; Lafayette Young; the Rev. Merle St. Croix Wright; A. V. V. Raymond, LL.D., president of Union College, Schenectady, N. Y., and S. H. Hardwick.

The toast of the evening was "George H. Daniels," and the guest of honor was the recipient of many tributes of admiration and affection from the speakers. At times the enthusiasm ran high, the oratory being of more than ordinary distinction. Mr. Daniels, who was for a long time the well-known general passenger agent of the New York Central & Hudson River Railroad, responded in very happy vein. He said that he felt that the testimonial was not so much in recognition of himself as it was of an idea that he had always been pleased to stand for. Advertising, he said, was the absolutely necessary means which the progressive business man required to develop any line of industry. The advertising of the American railroads was the backbone of the present civilization, and had done more to promote interstate and international commerce than any other factor in present or ancient times.

William Marconi to Lecture Before the New York Electrical Society.

Mr. William Marconi will lecture before the New York Electrical Society, at the auditorium of Horace Mann School, Teacher's College, Columbia University, Wednesday evening, March 28. Word has been received that Mr. Marconi will make a special trip to this country to deliver this lecture, which was postponed from January 16 because of Mr. Marconi's illness.

The 257th meeting of the society was held at the Edison auditorium, February 21. Mr. Robert T. Lozier lectured on "The Fundamental Principles of Gas Engines and Gas Producers." The lecture, which contained a large amount of carefully prepared and most valuable data, is to be published by the society. Its delivery was followed by an animated discussion, in which Messrs. Norris, Larwill, Hallberg and Bijur took part. The following members were elected: Isaac Fidler, Harry C. Fling, Daniel Hurley, Harry Pickhardt, James H. Rogers, James L. Wiltse, S. B. Burroughs, James K. Hooper, Carlton A. Graves, Richard E. Brown.

Illuminating Engineering Society.

The Illuminating Engineering Society will hold its next regular meeting in the Edison Auditorium, 44 West Twenty-seventh street, New York city, on Friday evening, March 9, at 8 P. M.

Papers will be presented on the following subjects: "The Luminous Arc," by E. L. Elliott; "The Inverted Incandescent Gas Burner," by Victor Rettich; "Illuminating Engineering from the Architect's Standpoint," by W. S. Kellogg.

National Electric Light Association.

The first list of questions for the 1906 question box of the twenty-ninth convention of the National Electric Light Association, to be held at Atlantic City, N. J., June 5-8, 1906, has been issued. The editor Mr. Paul Lupke, 222 East State street, Trenton, N. J., is desirous of securing responses as soon as possible.

ELECTRIC ELEVATORS—III.

BY E. R. CARICHOFF.

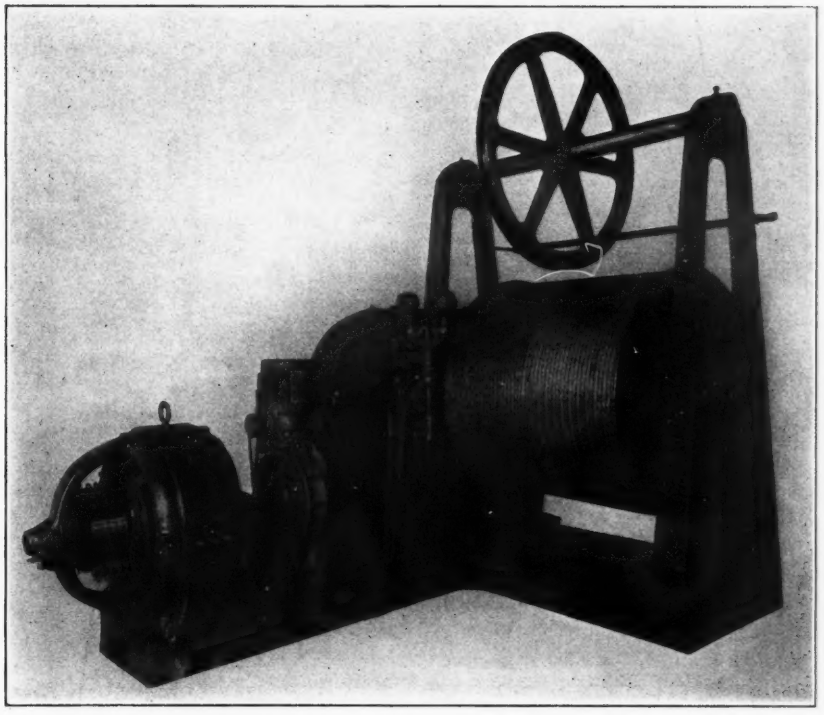
In a previous article[1] under this heading, attention was called to recent practice in regard to frequently operating magnet switches and the use of the toggle action, butt-contact type was recommended as by far the most satisfactory.

As an example of a variety of this type of switch, illustrations are here shown of some elevator controllers which accompany the elevator installation now being made by the National Elevator Company, 400 West Twenty-third street, New York, for the large new plant of Robert Hoe & Company, on Grand street, New York.

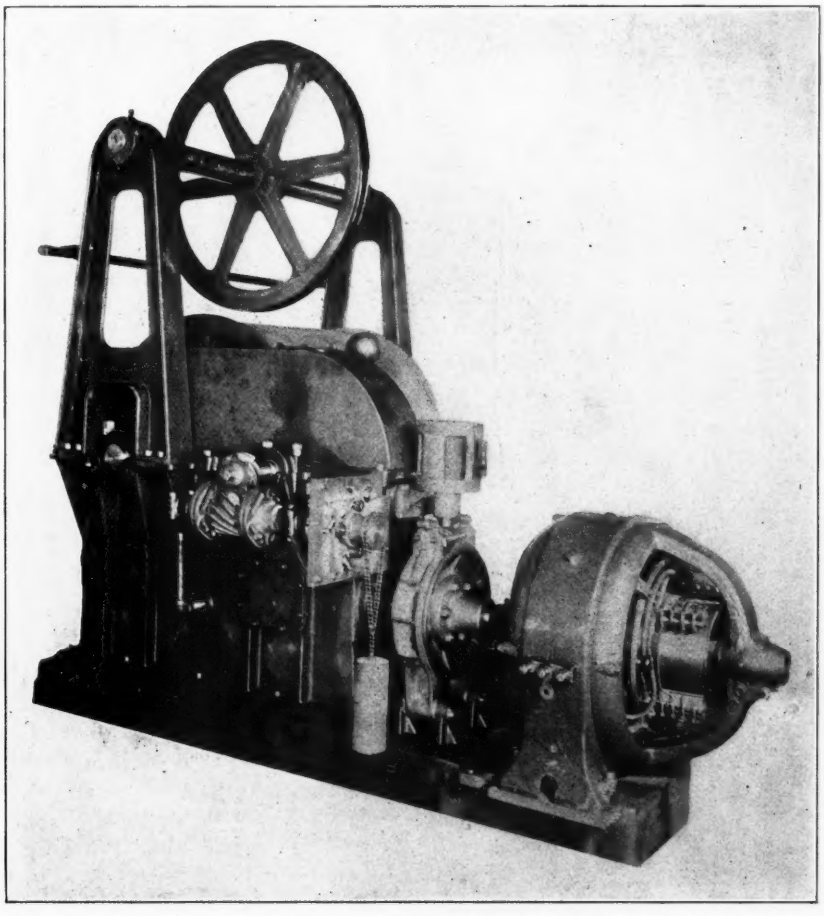
The elevators were designed to meet the special requirements of the engineers of the purchaser. The controllers are in many ways unlike any heretofore designed, and yet without previous experimenting, the results of the preliminary test made at the elevator company's works were in every way satisfactory.

For the switches where the amount of opening is small, phosphor bronze strip one inch wide and one-sixteenth inch thick and about ten inches long, is given a curved set and one end is screwed to one terminal block; the free end is provided with removable tips and is pressed against the other terminal block by the arm of a magnet acting near the middle of the bent bronze strip.

[1] ELECTRICAL REVIEW, September 9, 1905.



FRONT VIEW OF MOTOR AND DRUM CONNECTIONS.



REAR VIEW OF MOTOR AND DRUM CONNECTIONS.

The number of strips required for each switch depends, of course, on the current to be carried, on the controller shown four strips are used for each switch. When the switch is required to open an inch or more, the bronze strips are fastened to a pivoted rocking piece to which the current is conducted through a flexible connection.

The illustration of the controllers shows that the heavy operating parts are attached to the base, where two large magnets throw the reversing switch by means of rods and a cam. This switch, which is placed between the two magnets, is thrown for one direction travel of the cam by one magnet and for the opposite direction by the other magnet, but it remains fixed in its set position so that the shunt field when excited is not disconnected from the armature circuits, but dies down gradually as the motor comes to a stop. Thus the sparking and danger of shunt-field discharge are avoided and a considerable armature current is made available through resistance for braking purposes.

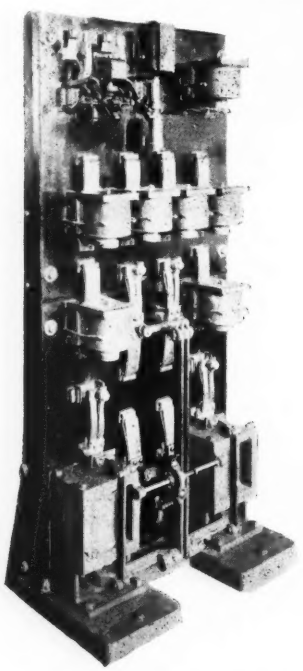
Either of the large magnets can close the double-pole line switch, which is located immediately above the reversing switch, and is held normally open by springs when both magnets are down. The

two back contacts of this switch close the dynamic brake circuit and the series field of the motor may be included in this circuit for self-excitation of the motor field.

Single-pole line switches are shown above each of the two magnets, which permit the use of up-and-down main line limit switches, and are provided with carbon tips and magnetic blow-out coils. Six accelerating magnet switches are provided for short-circuiting the starting resistances and the series-field coils. One is placed on each side of the double-pole line switch and four in line immediately above. These are the switches previously referred to where the required opening is very small. There is no arcing and the rubbing is sufficient to keep the contacts clean.

In the middle of the board at the top is the regulating solenoid for the accelerating magnet switches, so arranged that these switches must be open before the current in the motor can be reversed.

On the upper right hand corner of the board is the fast-speed magnet, which is excited by wire from the car switch, and



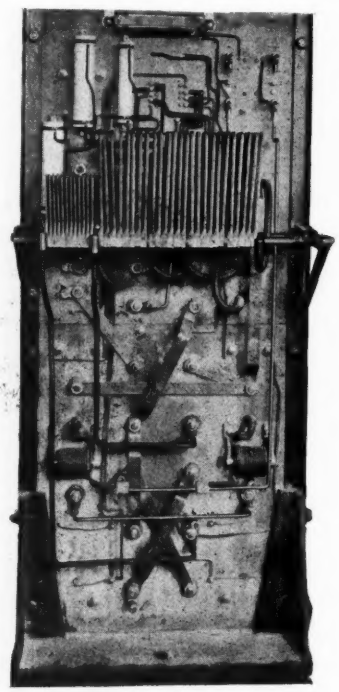
FRONT VIEW OF CONTROLLER BOARD

inserts resistance in the shunt field of motor for an increase of the car speed.

At the upper left hand of the board is a double-pole, over-load, no-voltage circuit-breaker, provided with special contacts to separate the motor and the operating circuits, so that when the circuit-breaker is tripped the motor can not supply current to hold off the brake, and all switches must come to the stop position.

The capacity of one machine is 6,000 pounds and of another 12,000 pounds, the car for the latter being equipped with sheave on top, so that the large car runs at about half the speed of the 6,000-pound car.

The gears are bronze, set tandem, and cut spiral for interlocking. The worms



REAR VIEW OF CONTROLLER BOARD.

are cut on solid-forged steel shafts. The brake pulley is V-shaped and the gripping shoes are leather-lined, making a very effective stopping device.

The motor is compound-wound and has its series-field winding short-circuited on the last point of the controller; two shunt-field speeds are given, one without resistance and one with resistance inserted in the winding.

Radiant Matter from the Sun.

That the aurora and magnetic disturbances are due to streams of matter radiated by the sun is sometimes doubted on the ground of a lack of periodicity. But J. M. Schaeberle shows that a periodicity can not be expected unless it is assumed that all such streams have the same initial velocity, which is improbable. An initial velocity of 376 miles per second would enable the streams to just touch the earth's orbit and then fall back. An initial velocity of 382 miles per second would send the matter out to infinity. At intermediate velocities the streams would cut the earth's orbit the second time after twenty-seven to sixty-five days. Such streams, encountered by comets, may account for fluctuations in their luminosity.—*Electrician (London), February 9.*

TELEPHONE ENGINEERING.[1]

BY J. J. CARTY.

Engineering may broadly be divided into two classes, civil and military. Military engineering is that which pertains to the conduct of war and is sufficiently understood to require no description. Civil engineering, as I am now using the term, comprehends all forms of engineering which are conducted without special reference to the operations of war. Falling within this definition of civil engineering we have electrical engineering, mechanical engineering, telegraph engineering, telephone engineering, and some others. As taught in colleges, however, and as generally understood, civil engineering is restricted and deals more especially with that branch of the art which pertains to the construction of bridges, waterworks, railroads, harbor improvements and other public works of like character.

Inasmuch as the telephone is an electrical instrument, and inasmuch as electrical phenomena exert a dominating influence in the telephone art, telephone engineering is classed as a branch of electrical engineering, although it will be shown as I proceed that telephone engineering comprehends important elements not at all electrical in their character; indeed, it is a recognition of the existence of these elements and a knowledge of how to deal with them adequately which constitutes one of the important requirements of telephone engineering. A good knowledge of electrical laws and a fair acquaintance with electrical machinery may be gained in our electrical schools; and graduates from them are, as a rule, proficient in these matters.

Telephone engineering comprehends not only these, but other factors, the existence of which is not generally recognized. In this paper I shall, owing to the limitations of the time at my disposal to-night, attempt to explain the nature of only some of these factors, indicating their most important bearing upon the general subject. From your own knowledge you will be able to supply many more instances, illustrating, perhaps, better than those which I have chosen, the ideas which I wish to make plain.

To describe the proper scope of telephone engineering in its relation to the telephone industry is to consider the function of the telephone engineer. Not so many years ago it was thought that the functions of the telephone engineer consisted of doing little more than to provide

[1] Paper presented at the 204th meeting of the American Institute of Electrical Engineers, New York, February 23, 1906.

and install switchboards. He was supposed to be consulted occasionally about the station apparatus, and later, when cables were introduced, his activities were extended so as to include the testing of cable after it had been bought and laid.

At the time of which I speak telephone companies took almost an exclusively switchboard view of the telephone business. A building would be selected by someone connected with the company and the engineer would be consulted principally as to the selection of the switchboard and the placing of it in position. The size and location of the building, its relation to the existing and probable future subscribers, and all of the vast number of other factors now considered so vital in determining such matters, received but scant consideration. So it was with cables; whether the cable should contain wires of No. 22, No. 19 or No. 16 gauge; whether the insulation should be of cotton, rubber or gutta percha—these were questions which were as likely to be settled by the purchasing agent as by the engineer.

To one acquainted with the conditions of those times this is not at all surprising, because the telephone engineer of that period shared with all the rest of the world the prevailing ignorance concerning matters which have since been proved by laborious investigations to be governed by well-established laws, the nature of which was then unknown.

The proper status of telephone engineering and the true scope of the functions of the telephone engineer differ as greatly from this primitive view as does the modern telephone system differ from that which obtained in the period about which I have just spoken.

I shall endeavor to give a correct view of the true scope of telephone engineering and to do so I shall broadly discuss a typical problem in telephone management, illustrating the various points I wish to make by reference to certain details which will be considered in connection with the problem chosen.

Let us take the case of New York city, with the suburban territory tributary to it, and assume that it is the intention of the telephone company to install within that territory a telephone system which will work at a proper degree of efficiency and at the same time yield to the investor a fair return upon his investment; and that it is necessary not only that this condition should exist during the first stages of the project, but that the undertaking should be so managed that this condition will be maintained indefinitely. With such a problem before the telephone management, what part of it should the management require the telephone engineer to work out? I shall answer this question by describing in general terms, and sometimes for the purpose of illustration, in considerable detail, what should be the work of the telephone engineer in such a case.

The first question which the engineer must decide is, what is the period for which such construction as may be required should be planned? This is a question of far-reaching importance and requires for its answer that a vast amount of data should be collected, and that careful and long-continued study and investigation should be given to a large number of factors, involving, among other things, first cost and character of construction of the diverse portions of a plant of such complicated nature, annual charges such as maintenance, depreciation and interest, and local conditions bearing upon the possibility of the renewal or extension at some future time of all of the elements of the plant.

In addition to this, due regard must be paid to possible changes in the art and also the fact that, owing to the exigencies of the business, many cases arise where it is necessary to carry out at the beginning, especially in underground work, all of the construction which may ever be needed.

At the outset the question of the period for which to plan depends upon the expectations of growth. With a given expectation of growth, the engineer, by taking into account all of the factors of the case and balancing the annual charges resulting from the initial investment against the cost of reconstruction and rearrangement of the plant at some future time, arrives at the economical period for which to plan.

In this work the predictions as to growth are of the first importance and, inasmuch as accurate predictions of this kind are attended with the greatest difficulty, it is essential that not only the judgment of the engineer, but that of the business management and all others who might be able to advise in connection with the matter, should be obtained.

At this stage of the work it is of the utmost importance that the bearing of these estimates of growth upon the future of the plant should be thoroughly understood by the business management, whose functions, in the nature of the case, exercise such a profound effect upon the extent and character of such growth. It is the duty of the engineer to make this point clear and to obtain from the business management serious and responsible estimates of future growth.

The number of lines which may be expected having been agreed upon, the question of for how long a period ahead we should plan is determined by a number of circumstances. For such conditions as obtain at New York, the period for much of the construction has been found to be from seventeen to twenty years. This figure is arrived at by taking into account a large number of factors, such as life of the central switchboard—which is placed at about fifteen years, the relative costs of placing in the subways a large number of ducts initially as compared with adding new ducts after a period of about twenty years, the uncertainty regarding the changes in the state of the art, and the difficulty of fortelling with sufficient detail conditions which are expected to obtain during a period so far ahead as twenty years.

In the case chosen for illustration, which was New York, the economical period was found to be about twenty years, and it was attempted to plan for conditions which would obtain in the year 1920 and for each year up to that date. The total number of lines to be provided for in the island of Manhattan is 300,000. The working out of the general plans for providing for this number of lines, which it was expected would be reached by the year 1920, constitutes what is known as the "300,000-line study." To give an idea of the nature of part of the work of the telephone engineer, I shall outline in general terms the character of this study.

Having determined upon 300,000 lines as the proper foundation of the study, and having received the proper authorization from the business management to proceed on that basis, the next step is to plot on a map the probable distribution of these lines. This is done, not by giving the location of each line, but by indicating by blocks the most probable distribution. Here again the judgment of the engineer must be assisted and directed by the business management, for next in importance to determining the total number of lines to be provided for comes the question of their distribution.

The number and distribution of lines having been agreed upon, the next step is to determine the number and arrangement of central office districts, the size and boundaries of these districts and the size and location of the central office switchboards.

It is conceivable, although obviously impracticable, that all of the 300,000 lines might be extended to one central office

and operated in switchboards there; it is only necessary to state such a proposition to exclude it from further consideration. On the other hand, it is conceivable that a central office might be established in each block; this also is absurd and needs no further consideration. Somewhere between these two extremes must lie the most economical size and number of central offices. The next stage in the problem is to determine this number; to do this no formula, simple or otherwise, is available. The only practicable method is to lay out the territory to be served, in accordance with a number of different arrangements of districts and centres, starting in, say, with ten centres and extending the study up to as many as thirty or forty, or even more. In the case of all these arrangements there would be certain elements of cost which would not be changed by the different arrangements of central offices assumed. Block-wiring and station instruments are examples of these. These elements of cost are omitted from the comparison. All of the items of cost, however, which vary with the different number and arrangement of central offices are computed, all of these being reduced to annual charges.

From these figures, as applied to the various layouts, the number of central offices and the districts which are ideally most economical may be seen. I say ideally most economical for the reason that the practical application of such results requires that a difficult and very complicated adjustment of the existing plant, to conform as nearly as possible to the ideal condition, must be carried out.

While it must appear, even from the brief statement of the steps of the study thus far described, that a vast amount of labor and computation are involved, it by no means represents all that must be done. Before there can be made a comparison of the relative economies of the various groups of offices, a series of studies within studies must be carried out upon many other important elements of the problem.

The first of these is the switchboard study. Before the switchboard study can be made, general methods of operating must be agreed upon, such as the method of handling toll business, whether it shall be done wholly upon a toll board or partly upon a toll board and partly direct from "A" positions; whether it shall be done wholly upon a "two-number" basis or substantially upon a "particular party" basis. The best method of handling local business must be determined. It must be decided whether the business shall be upon call wires or otherwise; what shall be the capacity of the call wire; what shall be the load which will be assigned to the various operators in the system, this in turn being dependent, among other things, upon the character of the service which it is thought necessary to render.

Having agreed upon these and other fundamental data, the question of the best type of switchboard, whether it shall be full multiple or partial multiple, whether it shall be of the transfer type or otherwise, must be settled. The limit so far as size is concerned of the multiple board, or any other type which may be considered, must be determined. Also there must be settled a very large number of questions cropping out at every point involving maintenance and operating expenses and methods. All of these factors having been duly weighed, the maximum size and type of switchboard is agreed upon.

The switchboard determinations having been made, the type of cable to be employed must be settled upon. Here again a series of studies is necessary. Of first importance in the cable study is the determination of the standard of transmission which is to be employed, not only for talk between offices within a zone such as Manhattan island, but also the standard of transmission which it is necessary to maintain between Manhattan island and the suburbs and between various points in the suburbs passing through Manhattan, and to long-distance points. The importance of this determination will appear when we consider the standard already adopted as the Manhattan standard, which is, assuming the use of the present common-battery apparatus, that the cable employed in Manhattan shall at all times be such that it will give in the worst case a talk as good as could be obtained between two central offices joined by a trunk cable of ten miles of the standard type having the No. 19 gauge conductors, with a mutual capacity of 0.07. If this standard were lowered so as to employ the use of No. 22 gauge cable instead of No. 19, it would permit the use of a trunk cable costing half as much as that required by the present standard, thus reducing the number of ducts required and in that way profoundly affecting the results of the study.

In considering the type of cable employed, not only must the standard of transmission be borne in mind, but in determining upon the specifications for the various types of cable needed a long series of special studies is required. These are conducted with a view to determining upon that form of construction in each case which will give the highest standard of transmission and at the same time preserve the best mechanical conditions needed for hauling in and out of the duct, and also be so constructed electrically and mechanically as to require a minimum of attention from the maintenance point of view. Not only must the various types of cables be carefully fixed upon when considered strictly from the cable point of view, but where suburban and long-distance circuits are to be considered the problem of loading cables presents itself. This involves so much work and study that to give even a brief outline of what it involves would require a paper which itself would extend far beyond the limits of the time allotted for this very general statement of the case.

The general features of the study having been determined upon and the time having arrived to erect a given central office at a centre previously located, the question of obtaining the necessary real estate and erecting the central office building presents itself. In such cases it is usually impossible to obtain the desired property exactly at the ideal centre. Practical real estate conditions must be met and, of the various parcels of property offered, that is chosen which, taking into account all of the circumstances of the case, results in the lowest annual charges. The distance of a given site from the main subways, the character of the neighboring buildings, the price at which the property can be obtained, the possibility of reconstructing the existing building which may be upon the property or the necessity of removing it and erecting a new one, and other similar points—all these have to be carefully worked out before a report can be made to the management setting forth the most economical land to purchase.

In other words, before even the land is bought a study must be made of a telephone building which might be erected upon it. Inasmuch as in nearly every case many different properties must be considered, studies for several different buildings must be carried out before the best combination can be determined. After these matters have been decided upon, the details of construction of the building must be further studied. This, as can readily be understood, naturally involves a vast amount of engineering work.

Thus far I have hastily sketched the outlines of a telephone development study as it is more particularly concerned with the local plant, but as the local plant must be, as time goes on, more and more intimately connected with neighboring plants in the suburbs, and with more distant plants reached by long-distance wires,

most careful study must be given to the best methods of establishing proper relations with those plants.

Without attempting to outline in any detail the nature and extent of the work involved in the methods employed in making a suburban toll-line study, and without going at all into the question of methods of establishing the service to long-distance points, I will say that, considering the broad features of these various classes of conditions, it has been found best, in the particular case which I have taken for my example, to divide the telephone business into three classes: local, suburban and long distance.

In determining what shall constitute the local class the engineer finds himself engaged in a problem of great magnitude which primarily concerns the business management and which is affected by important public and economic considerations as well as by engineering factors and methods. If the local zone is made too extensive it greatly increases the magnitude of the trunk line plant from which no toll revenue can be derived. This fact reacts upon the rates in such a manner as to make it impossible to give as low a station rate as might otherwise be the case. This tends to restrict the growth of stations and hence will act as a check upon the growth of the business at large.

The local zones having been determined upon, it must next be decided what shall be the limits of the suburban business and what shall be classed as long-distance business. Without attempting to explain the various points necessary to be taken into account in determining these questions, I will say that they involve not only those physical factors ordinarily considered to constitute engineering, but that they involve the methods of calling which may be permissible on the part of the subscriber, the entire system of toll rates which may be adopted by the telephone company, the question of whether the subscribers' names and numbers should be listed or not, and other questions of this nature.

When I review the outline of the methods and magnitude of a telephone development study, such as I have here briefly sketched, I am not surprised that some who superficially consider the subject are inclined to doubt the value of results obtained in this way. This feeling is strengthened when they consider the nature of some of the fundamental data upon which all of the work rests. For instance, unless there is made a fairly correct forecast of the probable growth of subscribers' lines for a period of fifteen or twenty years in advance, it is clear that substantial errors will be made; but more than this, it is necessary not only to forecast the total number of lines expected, but their location must be determined within close limits. But this is by no means all. Not only must the location of the lines be decided upon, but the number of calls per day which may be expected over each line must be estimated; not only must the number of calls which are expected be correctly determined, but the time of the day during which these calls may be expected must be arrived at in some manner. Even more than this must be done, because it is necessary not only to know all of these facts, but also it must be known where the calls are to go. We must also know what proportion of these are likely to be toll calls, what proportion long-distance calls, and various other factors of like nature must be determined.

There can be no doubt that telephone development, as thus viewed and as correctly viewed, presents abundant opportunities for errors, and that such errors must lead to expenditures of large sums of money, which, if infallible data were obtained, would not be required.

But conceding all this, what is the alternative method which we can follow? If we are to abandon the method of study herein described, what shall be substituted for it? By what plan shall we proceed which will enable us to arrive at a more economically constructed system? What method shall we adopt which will enable us to proceed without answering such questions as those which the present method of study undertakes to answer? It is obvious that what are erroneously called "common-sense" methods might be employed. Buildings might be erected in various locations in a city, chosen after an inspection of the region; they might be substantially constructed and provided with switchboards. These buildings might be joined together by subways, and in the subways cables could be located. Suburban and long-distance trunk line subways might also be constructed, and there is no doubt that according to such a plan telephone business could be carried on. But have we, after all, in following this method, avoided answering any or all of the questions with which the study undertakes to deal? Most certainly we have not, and while it might not be appreciated, every step taken in this so-called common-sense method really makes a direct, though unconscious and unintelligent, answer to all of the questions propounded and dealt with in the formal study. If, following this common-sense method, it is decided to erect at a given location a central office building with a switchboard of a given size, this office must be intended to serve a district of some definite form. If, as would of course be the case, other central office buildings are erected at other locations, they too must be constructed with reference to fixed districts and their number must be determined with reference to the expected growth in subscribers; so that after all the magnitude of the expected growth is a factor which is unconsciously dealt with. But in determining upon the size of the switchboard and its construction, whether we realize it or not, a definite, though unwitting, answer is made to the questions of what shall be the rate of calling, what shall be the destination of the calls, what shall be their character, and at what time they shall occur. The switchboard and building must be planned for some set of conditions which can be established only by data of this character. Merely ignoring these questions and erecting the switchboard and arranging central offices without making a study does not avoid answering the questions, for by the construction carried out a direct and unequivocal answer to all of these questions is made, yet without giving consideration to any of them or even recognizing their existence.

So it is with subway construction. It is easy enough, after central offices have been located, to plan for a subway joining those offices, but somebody must answer the question of how many ducts shall be provided in this subway. This can be done by the method outlined in describing the study, or it can be determined at the time by somebody who is opening the streets. It may be done, on the one hand, by engineers after careful study with all the facts before them, and after having analyzed the statistics of the past and having exhausted all possible methods of throwing light upon the subject; or it may be done by a man in the street with a pickaxe. Those who would follow the pickaxe method would not avoid questions which the engineer has recognized and has undertaken to answer. They would, by the number of ducts they put down and by the character and magnitude of the other construction, give their answer to all of these questions without having considered any of them. As to which of these two methods should be followed, the telephone company must decide.

Thus far in my outline of that part of the telephone engineer's duties which pertain to development studies, I have dealt more particularly with the physical features of the work. Ordinarily, engineer-

ing has to do principally, if not exclusively, with physical factors, but telephone engineering has not only to deal with physical factors of the utmost complexity, but it has also to deal with commercial questions which, of themselves, would seem to be only remotely connected with the work of the telephone engineer, but which really vitally affect it. Telephone engineering presents more factors of this nature than, I think, are to be found in many other branches. Take the case of a civil engineer who has before him the problem of constructing a masonry dam. This presents an instance involving solely physical factors. The stability of the dam or its capabilities of impounding the necessary amount of water are in no way affected by any action which the board of directors of the water works company may take with reference to its dealings with their customers.

It is not so with telephone engineering for, as I will presently show, a telephone toll line and switchboard system might be designed in accordance with the highest state of the art and constructed so as to give the best efficiency and yet by the action of the business management, causing the adoption of what might seem to be a reasonable commercial practice, the operativeness of the switchboard system might be totally destroyed. This idea will be readily comprehended when we consider what would happen to the present toll board at Cortlandt street, operating on the recording basis, using the two-number method of calling, if, by some change in business plans, the particular-party method in use extensively in many other localities were adopted. Only a brief consideration of this case is required to show that, in addition to the present recording operator, a second set of operators would have to be employed, who would be required to call up the subscriber desiring the toll connection and obtain from him the details of his call. The adoption of such a method, while in itself a wasteful and inefficient one, would in the case I have chosen require the radical reconstruction of our entire toll-board plant. More than this, the adoption of such a method would render it impracticable to follow the direct-line trunking method which is now possible by the use of the two-number plan of calling. The abandonment of this method would require that such toll lines be handled from toll boards. The magnitude of the revolution which this would make in the engineer's plans will be seen when I say that whereas, by the two-number method, one toll board occupying one floor of the Cortlandt street exchange is sufficient, there would be required, if the particular party method were employed exclusively, as many as five or six toll boards occupying five or six floors in the Cortlandt street building, and requiring five or six times as many operators for their working. This is one of the best examples which could be given as showing the peculiar relation which obtains between telephone engineering and the business management of telephone companies.

Another example, perhaps even more far-reaching in its effect upon the work of the engineer, is the question of whether the telephone company shall charge for its service on the flat-rate plan, or by messages as is now generally the case in this neighborhood.

Under the flat-rate method of charging, in large cities, the more times the customer uses his telephone during the day the greater is the expense to the telephone company. This is due not only to the increased number of operators required, but also to the increased switchboard sections needed for them and to the increased trunk-line plant. By the method of flat-rate charging there is no motive for the telephone company to encourage an increase in the number of calls. For this reason a flat-rate plan would have to be so engineered and the rate would have to be so established that extension stations, desk stands and other auxiliaries tending to make the use of the telephone easy and therefore more frequent, must be discouraged.

The existence of the flat rate in such cases would not only be attended by all of these consequences, but many others, one of which in particular is of great importance. I refer to the excessive use of the subscribers' line which such a rate engenders. The consequence of this excessive use is that the busy calls attain such serious proportions that it is difficult, if not absolutely impossible, to give satisfactory service. This trouble from busy calls has at times attained such serious proportions that engineers, in various places, have exerted extraordinary efforts to mitigate the evil, but without success. This difficulty having been caused by commercial methods could not be overcome by the engineer employing physical methods. The solution of this difficulty lay with the business management, and consisted in the adoption of a proper system of message rates. Once such a method was put into force all of these difficulties which I have enumerated as pertaining to the flat rate, and many others which I have not taken the time to explain, disappeared.

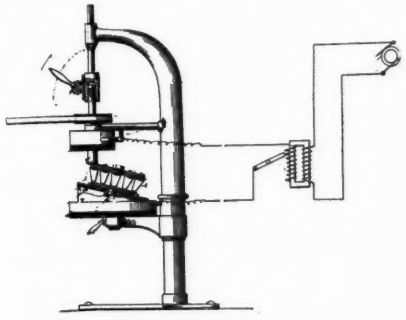
(To be concluded.)

An Investigation Into the Fluorescent Effect Due to the Secondary Rays of Radium.

An investigation has been made by Herr K. Siegl to determine whether the secondary rays thrown out by substances exposed to radiation from radium cause fluorescence, says the *Physikalische Zeitschrift* (Leipsic), February 15. For the purpose of research, a capsule containing a few milligrammes of radium bromide was enclosed in a thick lead case having an opening on one side. This case was placed so that the opening was directed downward against the materials to be investigated. Just above the case was a fluorescing screen, which at the point immediately over the lead was covered with black paper so as to eliminate any possibility of action due to the filtering of direct radiations through the lead. The table immediately below the bromide was arranged so that different materials could be slipped upon it, taking a definite position, and the screen was then exposed only to the secondary radiations thrown off from these materials on account of the direct radiation emitted by the radium through the opening in the lead case. The substances investigated were wood, aluminum, ebonite, glass, iron, nickel, copper, silver, zinc, platinum, gold, mercury, lead, and some other metals. These could be clearly divided into groups according to the action produced. The secondary radiations caused fluorescence of the screen to different degrees, wood having the least effect, ebonite and aluminum coming next, then iron and nickel, copper and zinc, followed by silver and tin, finally the heavy metals—platinum, gold, mercury and lead. The effect not only varied with the materials, but with the form of the sample under investigation. It appeared to depend upon the atomic weight more than upon the specific weight. It also depends upon the thickness of the exposed sheet. This was tested by placing successively several layers of metallic foil one upon the other. The action increased as the number of layers was increased, showing that it was not due to a surface effect, but the radiation proceeded from points within the metal. By placing between the exposed metal and the radium a screen of hard rubber the effect is weakened, but not uniformly for all metals. This action was greater with aluminum than with lead. It appears that the secondary rays of all bodies possess similar penetrative powers, but the character of these rays is different for different materials.

Electrical Patents.

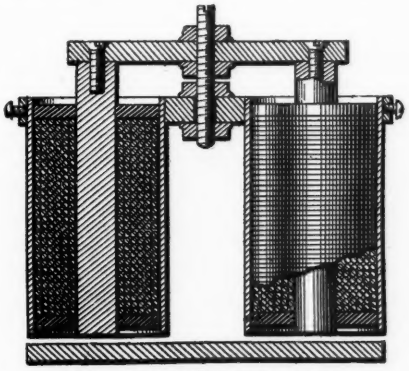
Samuel S. Eveland, Philadelphia, Pa., has obtained a patent (811,137, January 30) for an improved electric riveter. One object of the present invention is to provide a simple, reliable and comparatively inexpensive apparatus for electric riveting. Another object of the invention is



ELECTRIC RIVETER.

to provide for localizing the heat of electrical resistance at the end of the rivet where the head is to be formed and to provide for silently forming the head. An electric riveter provided with an electrode constituting a header, means for rotating said electrode to localize the heating effect at the end of a rivet, an electrode constituting a support for the rivet, and devices for causing said electrode to approach, so as to head-up the hot end of the rivet.

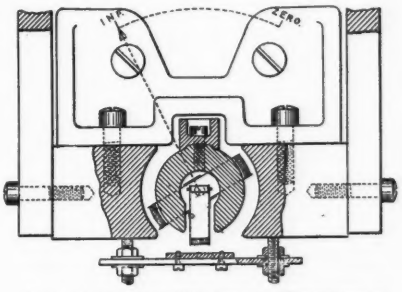
Hermann G. Pape, New York, N. Y., has obtained a patent (812,445, February 13) on an improved multipolar electromagnet. This invention relates to a novel electromagnetic device, the object being to provide a simple, inexpensive and compact structure which will exert a maximum attractive force with a minimum ex-



MULTIPOLAR ELECTROMAGNET.

penditure of electrical energy. To the accomplishment of this primary object and others subordinate thereto, the invention consists in connecting a plurality of magnetic cores in series and surrounding these cores with sleeves connected in series and in interposing between each sleeve and core a coil of wire through which a current of high voltage but low amperage may be passed to powerfully energize the device thus produced.

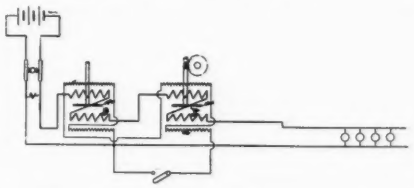
Sydney Evershed, Streatley, England, has obtained a United States patent (812,196, February 13) on an improved apparatus for measuring electrical resistance, assigning it to himself and Evershed & Vignoles, Limited, of Chiswick, England. The invention relates to apparatus used for measuring electrical resistance, and particularly insulation resistance, and it is specially applicable as a portable testing set intended for testing and measuring the insulation of electric circuits at voltages commensurate with the working voltage of the circuit. The invention consists in the combination with a hand-operated dynamo, a direct-reading ohmmeter having moving coils, and an index-finger rotatable, relatively, to a fixed magnet, the moving coils having their common terminal connected with the axis of the index-finger, a pair of flexible conductors connected to the axis, a pair



APPARATUS FOR MEASURING ELECTRICAL RESISTANCE.

of flexible conductors upon an insulated sleeve of the axis, and connected to the other end of one of the movable coils, a pair of flexible conductors upon an insulated sleeve of the axis and connected to the other end of the other movable coil, six contact-clamps arranged about the axis and adapted to make contact with the flexible conductors, circuits thereto from the dynamo and the external terminals, and means operated from the dynamo for causing the clamp-contacts to intermittently and alternately make contact with, and release the flexible conductors.

An improved system of calibrating recording watt-hour meters has been invented by Douglas P. Morrison, Newark, N. J. (812,436, February 13). The invention relates to a system of calibrating a recording watt-hour meter. The invention consists in subjecting a standard meter to the same load as the unknown meter, but in such a manner that the current passes through the standard meter without operating its recording mechanism, starting and stopping the recording mechanism of the standard meter at will and comparing the observed units of the unknown meter with the recorded units of the standard meter. The means for carrying this object into effect may vary considerably; but a simple and effective arrangement consists in placing the field coils of the standard and unknown



SYSTEM OF CALIBRATING WATT-HOUR METERS.

meters in circuit with each other and in circuit with the mains leading from the source to the load in connecting the potential circuits of the two meters with the mains and by interposing a switch in the potential-circuit of the standard meter.

Advantages of Electric Motors for Driving Induced-Draught Fans.

A suitable type of motor for driving induced-draught fans is a multipolar series-wound machine with speed regulation obtained by shunting the field coils by means of a switch connected to a resistance. A thirty per cent range in speed is convenient, and can be obtained in this way in eight or ten steps. The fan is that usually employed with the steam-engine drive. Comparing the electrical equipment with the steam-driven equipment, there is first an advantage of twenty-five per cent as regards cost in favor of the motor. If there is any difference as regards breakdown, it is in favor of the motor. The motor costs less in attendance, repairs and renewals. The only attention it needs is the renewal of the brushes about once a month, and changing the oil in the bearings. A special advantage in favor of the motor is that it keeps up the air supply so long as the voltage at its terminals holds out. It will continue to run at its regular speed until the governors on the main engines have reached their limits. On the other hand, the steam-driven fan will vary in speed with every variation of the steam pressure. Again, when for any reason the load is thrown off the station by opening of the circuit-breakers the electrically driven equipment shuts down, while the steam-driven fan tends to speed up and increase the draught just when it is not needed.—*The Electrical Review (London), February* 9.

Reviews of Current Engineering and Scientific Literature.

Electrical Properties of Alloys.

In this discussion of the properties of alloys, by Mr. A. H. Sexton, the author takes up briefly the electrical properties of these metals. The influence of the addition of one metal to another on the electrical conductivity of an alloy is marked. As a rule the conducting power is considerably reduced. Alloys in general may be divided into two groups, according to the way in which the conducting power of the alloy is related to that of the constituent metals. In the first group the alloy behaves exactly as if it were a mere mixture of the two metals, the conducting power rising or falling as the percentage by volume of the second metal is increased, according as the starting point is the metal of greater or less conductivity. The curve for conductivity therefore is a straight line. This may be called the normal curve, though, as a matter of fact, a comparatively small group of alloys gives it. A typical example is the tin-zinc series, consisting of lead, zinc, tin and cadmium, and their alloys with another. It is obvious that the addition of a small quantity of one of these metals to another will have a very small effect upon the conducting power. With alloys of the other metals, with the members of this group or with one another, the result is very different. The conducting power of the alloy is always less than what it would be if the metals all behaved like the metals of the zinc-lead group—that is, when the curve is plotted it will always lie entirely below the straight line joining the conductivities of the two metals. The curve itself may in general take two forms. Alloys of the two metals of class one, with those of class two, show a somewhat curious behavior. If a small quantity of the metal of class one, say, tin, be added to a metal of class two, say, copper, it causes a very rapid diminution of conducting power, while the addition of a small quantity of, say, copper to tin has a small effect upon its conducting power. When the curve for such an alloy is plotted it takes therefore somewhat of an L-shape, the vertical portion falling sharply to a minimum, and then the horizontal portion slowly rising. The falling portion is, however, not always continuous, but may show a sharp break or change of direction. These breaks do not seem to correspond to the formation of definite chemical compounds. With metals of class two alloyed with one another the curve is somewhat different, for here the addition of a small quantity of either metal to the other causes a rapid diminution of conductivity, and the curve therefore assumes roughly a U-shape, the length of the two vertical arms being unequal, and in the proportion of the conducting power of the constituent metals.—*Abstracted from the Mechanical Engineer (London), February* 10.

The Capacity of Mica Condensers.

The differences in the value of the capacity of the same condenser observed in determinations made at different times with different galvanometers have given the impression that mica condensers are not available for measurements of high precision. The manufacturers of the best condensers guarantee an accuracy of only one-quarter per cent. The reason for this is that on account of the different periods of the galvanometers, a greater or less amount of the absorbed charge of the condenser is given off during the whole period of the first throw, so that with different galvanometers, different quantities are discharged. This difficulty can be avoided, according to Mr. A. Zeleny, if the period during which the condenser is allowed to discharge through the galvanometer be limited so that only a negligible part of the absorbed charge is allowed to escape. By adopting such a method in testing the capacities of good condensers can easily be determined within 0.05 per cent, and an accuracy of 0.01 per cent is attainable. The author has tested this method for measuring the capacities of different types and has found that it gives very accurate results. The discharge curve of a good mica condenser shows that for a time of a few hundredths of a second there is no appreciable discharge of the absorbed charge. If the time of discharge is extended to twenty-five seconds, more or less, the absorbed charge begins to escape. However, the period during which there is no loss of the absorbed charge is so great, compared with the time required for the discharging current to reach its maximum value, that there is no necessity for great accuracy in fixing the period of discharge. The method employed involves the use of a simple key having two points of contact. These are opened successively by depressing one knob. In the normal position the key charges the condenser. When depressed it first opens the battery circuit and then closes the galvanometer circuit, finally opening the latter. The key is operated by a quick tap, and the period elapsing between the closing of the galvanometer circuit and its opening is regulated by regulating the speed at which the tap takes place and the distance between the two tongues of the key. There is no need for great accuracy in doing this for ordinary work. For very accurate measurements a mechanical device could easily be arranged for giving more exact time intervals. The author found that it is not difficult to adjust the key for good results, and when applying the method the variations in the capacity, when measured by means of different galvanometers, were greatly reduced. Work with the instrument showed further that it offers a convenient method of determining the constants of ballistic galvanometers, when the free charge capacity and the temperature coefficient of the condenser are known. The author suggests that the capacity of the condenser be defined as the quantity of electricity it retains unabsorbed while its plates are at a difference of potential of one volt; and, further, that when the time between the charge and discharge is so short that it is never fully charged, that the observed capacity should be designated by some such term as "effective capacity," this value being defined only for that particular condition.—*Abstracted from the Physical Review (Lancaster), February.*

Electric Power Distribution in North Wales.

The system here described is unique in Great Britain, for it is to be driven entirely by water power and it will distribute power by overhead wires at high pressure. The hydraulic power utilized is Llyn Llydaw, a lake on Mount Snowdon, 1,420 feet above the level of the sea. This lake is about a mile long and 350 yards wide. Water is maintained at a high level by a long watershed. The power-house has been built at Cwm Dyli, which is at the base of a sharp descent from the lake. The head available here is 1,150 feet. The water is conducted to the power-house through a tunnel, a short canal and a pipe line about one and one-half miles long. It is estimated that 6,000 horse-power or more is made available, and this may be added to by in-

creasing the height of the natural dam of the lake by thirty or forty feet. Within a radius of fifteen miles of the power-house there are several large slate quarries, which are ready for electric power. The tunnel by which the water is drawn from the lake has been cut from a point in the bed of the lake at a depth of thirty feet from the surface. It is forty-eight inches in diameter and is lined with concrete. It is 200 yards long. The open cut made necessary by the loose soil is 200 feet long. The pipe line is divided into three sections, the upper part being thirty-inch, single-riveted; the middle part thirty-inch, double-riveted, and the lower part twenty-seven-inch, lap-welded pipe. There are two pipes running the entire distance. The power-house contains four Pelton wheels, with space for two more. Each of the four wheels is connected to a 1,500-kilovolt-ampere, three-phase generator with an exciter on the same shaft. They run at 500 revolutions per minute and have twelve poles, giving a frequency of fifty cycles per second. The alternator voltage is 10,000. The switchboard is of the usual Ferranti type, the switches breaking under oil, with the handles only on the front of the board. There are no tripping coils on the generator switches and no fuses, but the feeder switches are fitted with overload relays. The feeder and generator boards are back to back, with a space between for the switches. All connections are made by bare wire supported on insulators. Bus-bars form a ring, at each end of which are total output panels. The ring can be divided as desired. For the power-house there are four sets of feeders running to different points. One is seven and one-quarter miles long, two thirteen and three-eighths miles long and the fourth seven and one-half miles long. The line consists, in general, of wooden poles placed 120 feet apart, though at some points lattice iron poles are used. Plain wooden bracket arms are used, the wires being arranged vertically one above the other. The insulator is of white porcelain mounted on an iron pin. Where the line passes along a roadway a galvanized iron ring with sharp points is placed twelve feet above the ground, and a board calling attention to the dangerous character of the line is fixed to it. At such positions a guard net is added, which is formed by stretching steel wires between angle irons bent to a wide-angled V bolted to the poles. The net is completed by running light wires across these wires every two feet. This guard net is earthed. Lightning arresters are placed on all routes every three miles. These are of the non-arcing type fitted with carbon resistance pencils. The arresters are fitted with a single-blade switch for disconnecting them from the line. At the power-house there is, in addition, a set of three horn arresters and a set of water jet dischargers connected to each side of the feeder bus-bars. Owing to the rough character of the country, great difficulty was experienced in the transportation of material. Traction engines were used wherever possible, and on steep grades a light track was laid down and a winding engine was placed for hauling material up the hill.—*Abstracted from the Electrician (London), January 26, February 2 and 9.*

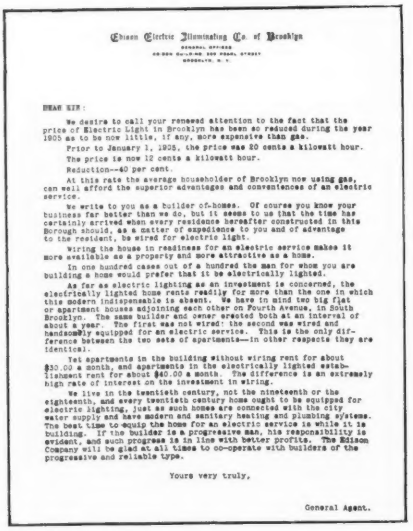
The Plant of the Vancouver Power Company, Limited.

Mr. Wynn Meredith completes here a description of the plant of the Vancouver (B. C.) Power Company, Limited. This plant utilizes the hydraulic power made available by driving a tunnel from Coquitlam lake to Trout lake, and conducting the water from the latter lake through a pipe line to the north arm of Burrard inlet, that branch of the straits of Georgia upon which the city of Vancouver is situated. The first installation consists of three equipments having a total output of 9,000 horse-power. Each unit consists of one revolving-field, engine-type generator running at 200 revolutions per minute and two Pelton water-wheels, one connected to each end of the shaft. The two wheels take water from a single pipe through a Y-connection and are fitted with deflecting needle nozzles. The needles are adjustable by hand and the nozzles are deflected by Lombard governors. The alternators, which are three-phase machines generating current at 2,300 volts, were especially designed to withstand a runaway speed 175 per cent in excess of the normal speed. The shafts are of hollow forged steel and carry the rotors centrally between the bearings, making a perfectly symmetrical arrangement, and loading the two bearings equally. Spatter water from the wheels is caught in a housing and passed through the hollow shaft to assist in keeping the bearings cool. The rotating element weighs 80,000 pounds. The exciting current is provided by means of either one of two direct-connected, water-wheel-driven generators coupled to induction motors which take current from the main bus-bars. The motor not only ensures exciting current in the event of wheel trouble, but serves as a governor, absorbing the power of the wheel in excess of that required by the exciter. The power-house is a plain, massive granite structure forty feet wide and 160 feet long. It is located just above high tide. Space is available for extensions as may be necessary to house an ultimate equipment of 40,000 horse-power. The switchboard is of the usual type and is equipped with Tirrill regulators and a full set of indicating and recording instruments. In place of the usual double-throw switches, two single-throw switches are used for connecting the generators to either one of the two sets of bus-bars. One of these sets is reserved for lighting and one for the railway load. It is possible to connect any one of the generators to either of the bus-bars, or to operate them in parallel. The current is transformed by three sets of three 500-kilowatt, air-blast transformers up to 23,000 volts for transmission. The switches are of the bayonet, air-break type, and contain no oil. When the switch is closed the bayonet compresses a spring behind the piston, which furnishes a slight blast of air at the precise moment the bayonet is withdrawn, thus blowing out the arc. In action the arc appears to be about one and one-quarter inches long when breaking a 2,000-kilowatt, 23,000-volt circuit. These switches enable transformers to be connected to either one of two sets of high-tension bus-bars. Immediately outside of the transformer building, which is placed just in the rear of the power-house, is a set of ram's-horn emergency switches operated either from within or without the building. There is a double forty-five-foot pole line carrying four three-phase circuits, two on each line. The wires are supported on nine-inch, umbrella-type glass insulators, mounted on special metal pins. There is a long span in the transmission line at Barnet, where a navigable arm of the harbor is crossed. The distance between supports is 2,750 feet. The conductors are 150 feet above high tide at the lowest point. Twelve seven-strand, nine-sixteenths-inch, galvanized plough-steel cables are used as conductors. The span runs from high ground on the north shore to twin towers on the south shore. Each cable is secured by means of a series of thirty-two of the nine-inch glass line insulators mounted in pairs, the cable passing between them. The strain is transmitted to the insulators by means of a clamp on the cable and an equalizing bar resting against the insulators. No special insulators were required. The Vancouver substation is on one of the principal streets of the city and contains two 500-kilowatt and one 1,000-kilowatt rotary converters for the railway and eight 500-kilowatt step-down transformers.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), February.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

The Edison Electric Illuminating Company, of Brooklyn, N. Y., is constantly on the alert to improve its methods of publicity. The advertising department of



Edison Electric Illuminating Co. of Brooklyn

DEAR SIR:

We desire to call your renewed attention to the fact that the price of Electric Light in Brooklyn has been so reduced during the year 1905 as to be now little, if any, more expensive than gas.

Prior to January 1, 1905, the price was 20 cents a kilowatt hour.

The price is now 12 cents a kilowatt hour.

Reduction—40 per cent.

At this rate the average householder of Brooklyn now using gas, can well afford the superior advantages and conveniences of an electric service.

We write to you as a builder of homes. Of course you know your business far better than we do, but it seems to us that the time has certainly arrived when every residence hereafter construted in this Borough should, as a matter of expedience to you and of advantage to the resident, be wired for electric light.

Wiring the house in readiness for an electric service makes it more available as a property and more attractive as a home.

In one hundred cases out of a hundred the man for whom you are building a home would prefer that it be electrically lighted.

As far as electric lighting as an investment is concerned, the electrically lighted home rents readily for more than the one in which this modern indispensable is absent. We have in mind two big flat or apartment houses adjoining each other on Fourth Avenue, in South Brooklyn. The same builder and owner erected both at an interval of about a year. The first was not wired: the second was wired and handsomely equipped for an electric service. This is the only difference between the two sets of apartments—in other respects they are identical.

Yet apartments in the building without wiring rent for about $30.00 a month, and apartments in the electrically lighted establishment rent for about $40.00 a month. The difference is an extremely high rate of interest on the investment in wiring.

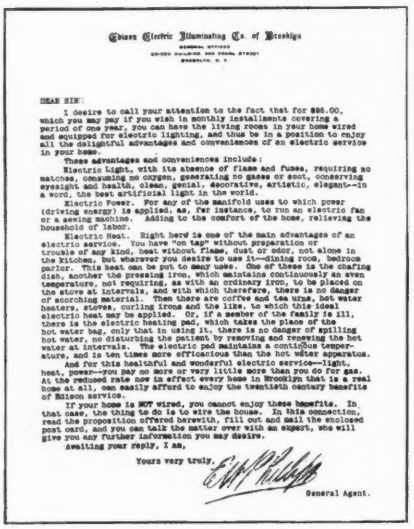
We live in the twentieth century, not the nineteenth or the eighteenth, and every twentieth century home ought to be equipped for electric lighting, just as such homes are connected with the city water supply and have modern and sanitary heating and plumbing systems. The best time to equip the home for an electric service is while it is building. If the builder is a progressive man, his responsibility is evident, and such progress is in line with better profits. The Edison Company will be glad at all times to co-operate with builders of the progressive and reliable type.

Yours very truly,

General Agent.

A Well-Thought-Out Letter to the Builder.

this company has presented from time to time some of the best examples of typography, and has also made many clever



Edison Electric Illuminating Co. of Brooklyn

DEAR SIR:

I desire to call your attention to the fact that for $66.00, which you may pay if you wish in monthly installments covering a period of one year, you can have the living rooms in your home wired and equipped for electric lighting, and thus be in a position to enjoy all the delightful advantages and conveniences of an electric service in your home.

These advantages and conveniences include:

Electric Light, with its absence of flame and fumes, requiring no matches, consuming no oxygen, generating no gases or soot, conserving eyesight and health, clean, genial, decorative, artistic, elegant—in a word, the best artificial light in the world.

Electric Power. For any of the manifold uses to which power (driving energy) is applied, as, for instance, to run an electric fan or a sewing machine. Adding to the comfort of the home, relieving the household of labor.

Electric Heat. Right here is one of the main advantages of an electric service. You have "on tap" without preparation or trouble of any kind, heat without flame, dust or odor, not alone in the Kitchen, but wherever you desire to use it—dining room, bedroom parlor. This heat can be put to many uses. One of these is the chafing dish, another the pressing iron, which maintains continuously an even temperature, not requiring, as with an ordinary iron, to be placed on the stove at intervals, and with which therefore, there is no danger of scorching material. Then there are coffee and tea urns, hot water heaters, stoves, curling irons and the like, to which this ideal electric heat may be applied. Or, if a member of the family is ill, there is the electric heating pad, which takes the place of the hot water bag, only that in using it, there is no danger of spilling hot water, no disturbing the patient by renewing and renewing the hot water at intervals. The electric pad maintains a continuous temperature, and is ten times more efficacious than the hot water apparatus.

And for this healthful and wonderful electric service—light, heat, power—you pay no more or very little more than you do for gas. At the reduced rate now in effect every home in Brooklyn that is a real home at all, can easily afford to enjoy the twentieth century benefits of Edison service.

If your home is NOT wired, you cannot enjoy these benefits. In that case, the thing to do is to wire the house. In this connection, read the proposition offered herewith, fill out and mail the enclosed post card, and you can talk the matter over with an expert, who will give you any further information you may desire.

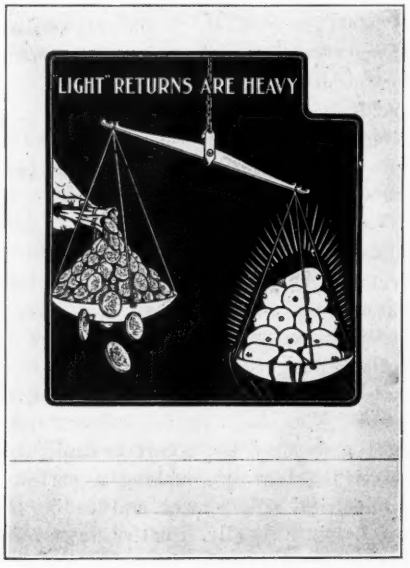
Awaiting your reply, I am,

Yours very truly,

General Agent.

A Letter to a Resident, Telling of the Advantages and Possibilities of Electricity in the Home.

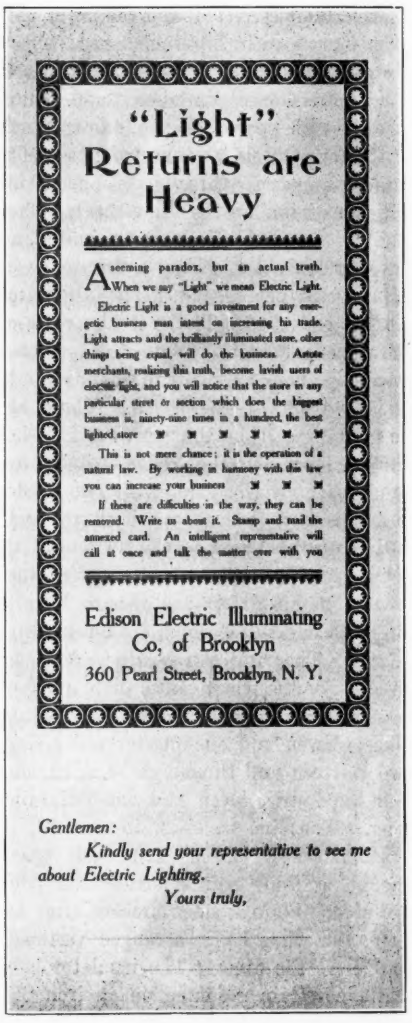
uses of follow-up systems and other methods of securing new business. The accompanying illustrations show two form letters which have had quite extensive distribution, and which make the suggestion with regard to the advantage of electric light and power in such a manner that considerable enquiry was secured. The neat appearance and the very choice expression of each of these letters might well be copied by companies who have not inaugurated this method of going after new business. In the one letter a direct bid is made for supplying current. The price is given, and attention is called to the considerable reduction recently made in the price per kilowatt-hour. The letter is directed to the house builder and a specific incident is pointed out, showing the advantage which had accrued through the use of electric light and power. The other letter takes up several distinct instances where electricity can introduce a great improvement and is directed to that class of resident who is already well established in the home, but whose house is



An Attractive Folder in Brown and White.

not wired for current. It is this specific information and the very close personal relation which is brought into effect that make this method of publicity successful.

The other illustration shows a mailing folder which was recently sent out by this company. The make-up of the folder is such that the typographical arrangement is pleasing to the eye, the argument is sound and convincing and the effort on the part of the prospect to secure additional data or to merely indicate his receipt of the card is very slight, as all that is necessary is the affixing of a stamp and the return of a portion of the original folder, which is easily separated



"Light" Returns are Heavy

A seeming paradox, but an actual truth. When we say "Light" we mean Electric Light.

Electric Light is a good investment for any energetic business man intent on increasing his trade. Light attracts and the brilliantly illuminated store, other things being equal, will do the business. Astute merchants, realizing this truth, become lavish users of electric light, and you will notice that the store in any particular street or section which does the biggest business is, ninety-nine times in a hundred, the best lighted store.

This is not mere chance; it is the operation of a natural law. By working in harmony with this law you can increase your business.

If there are difficulties in the way, they can be removed. Write us about it. Stamp and mail the annexed card. An intelligent representative will call at once and talk the matter over with you.

Edison Electric Illuminating Co, of Brooklyn
360 Pearl Street, Brooklyn, N. Y.

Gentlemen:

Kindly send your representative to see me about Electric Lighting.

Yours truly,

The Same Folder Opened Up, with Return Postal Attached.

by reason of the perforations at the proper place.

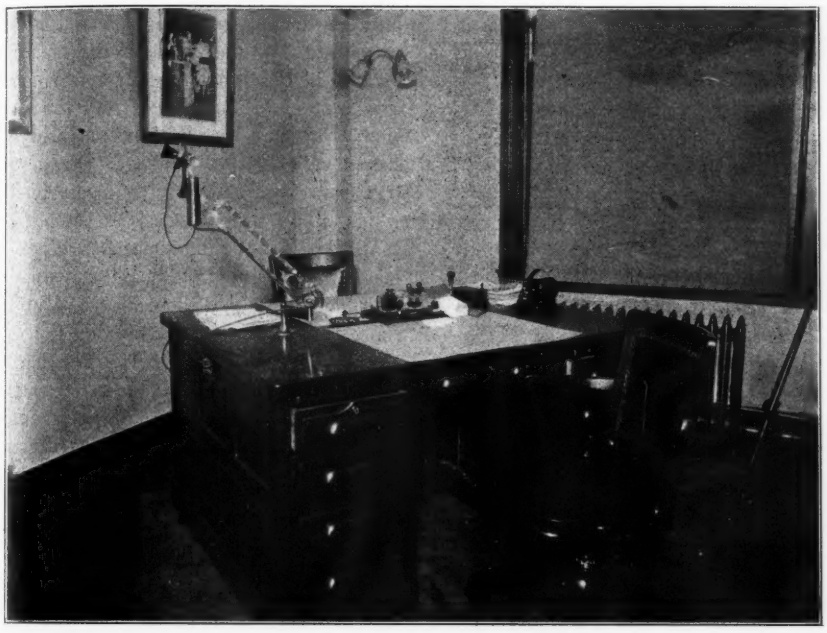
In this folder not a little of its attractiveness lay in the selection of type and the colors employed. The front when folded down was in a dense sepia, the interior being a flat blue-green. The catchphrase is also attractive and secures at once the interest of the reader by the seeming paradox.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Adjustable Telephone Bracket.

The accompanying illustrations show a new telephone bracket which has been placed upon the market by the Fox-Borden Manufacturing Company, 110 West Thirty-fourth street, New York city. The bracket combines a swinging arm, which has at the same time an up-and-down reciprocating movement. A cam spring motion balances the telephone at any point from an upright perpendicular down to a position considerably lower than the horizontal. This is made possible by a change in tension of the spring exactly equaling the weight of the telephone, doing away with friction and allowing the instrument to be moved with a simple pressure of the hand. It is claimed that there are no wearing surfaces, no point which requires oiling, and that in mechanical construction the best material and highest type of workmanship are employed.



ADJUSTABLE TELEPHONE BRACKET RAISED ABOVE AND SWUNG AWAY FROM DESK.

ADJUSTABLE TELEPHONE BRACKET BELOW HORIZONTAL AND RESTING WITH RECEIVER OFF HOOK.

The bracket is possessed of several different motions. The telephone can be moved to any position desired by the user, either in a standing or sitting posture, and for a child the instrument can be brought very close to the floor. The transmitter and receiver turn so as to face the user at any angle, the base of the bracket turning on a pivot through the whole arc of a circle. In this way the transmitter reaches and faces any point within a radius of two feet from the given centre. An improved switch and terminal post are used, concealed in the heart of the bracket.

ADJUSTABLE TELEPHONE BRACKET USED ON WALL.

The fixture may be placed at any convenient point, requiring the use of three screws for fastening. The bracket is covered by patents in the name of Charles H. Borden, of Stamford, Ct., who is the general manager of the company; Mr. Farnham Fox, New Rochelle, N. Y., being president.

A Multiple-Font, Electrically Operated Type-Composing Machine.

One of the most widely used and practical devices of modern mechanical ingenuity is the automatic type-setting and casting machine. The operation of devices of this character has made possible, more than any other factor, the immense volume of literature which is now at the disposal of all classes of people. The one great aim of the inventor of type-setting and casting machines is to produce a uniform product and at the same time cut down the time of composition to a minimum. Some of the most successful of present-day type-setting machines have labored under the disadvantage of using separate matrices for casting the letters, necessitating the assembling of individual matrices into composite lines, and then casting as a whole; or in the other case casting the individual units of type and then assembling these. Another disadvantage of many forms of these machines was in their inability to make available, from one set of matrices, more than one or two different characters of type, the space available on the ordinary matrix not being large enough to accommodate several dies, and the multiplying of magazines or matrix holders making the machines too cumbersome.

The machine described and illustrated herewith is the invention of John R. and Gustave A. Pearson, and is placed on the market by the F. Wesel Manufacturing Company, Brooklyn, N. Y. The machine is claimed to be simple in construction, and its most valuable feature lies in its multiple-font matrix magazine, whereby changes of type face within the range of this magazine can be made by merely manipulating a lever.

The matrices are formed on six bars, each bar carrying characters of a different body thickness. The bars shown are four-sided, each carrying the same characters,

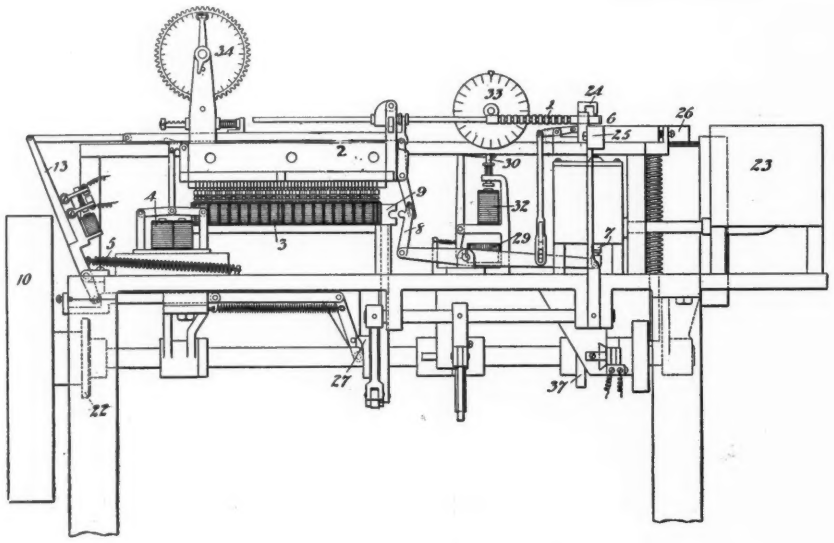


FIG. 1.—FRONT ELEVATION.

but of a different font. Each bar is furnished with its own mould and casting mechanism to provide for the different type bodies required by the matrices. In operation the matrix bar is moved longitudinally over its mould, successively presenting the matrices to it, and when the desired matrix comes into position a pin arrests further movement of the bar, whereupon the matrix is clamped down and type metal is injected, leaving the mould ready for the next casting operation. The matrix bars are mounted in sleeves to which they are splined and through which they are thus free to slide in their movements to and from the moulds. Each sleeve carries a pinion, and the pinions are all engaged by a common rack. When it is desired to change from one font to another this rack is shifted, turning the bars over until the proper side is brought to the operative position. By using hexagonal or octagonal bars the number of fonts may be increased to six or eight. The operation of the machine may be better understood by referring to the front elevation, Fig. 1, and the plan view, Fig. 2. The matrix magazine is shown at 1 in the drawings. Each matrix bar is provided with a carrier 2, which slides over a series of stop pins controlled by the magnets 3. When a magnet 4 is energized it releases one of these carriers which shoots forward under the action of a spring 5, moving the matrix bar over the mould 6. The bar is stopped when the desired matrix reaches the mould by one of the stop pins engaging a lug on the bottom of the carrier. There is a mould for each matrix bar, and each mould is provided with its individual injector 7. Normally these injectors lie idle, but when a carrier is actuated it connects the respective injector with a cam by throwing the link 8 into engagement with the slide 9. The cam shaft which normally lies idle is set in motion every time a key of the keyboard is touched by means of a friction clutch which couples it to the rotating pulley 10. However, the operation of this clutch is delayed until the matrix bar has been arrested with the desired matrix over the mould. The method of doing this may be

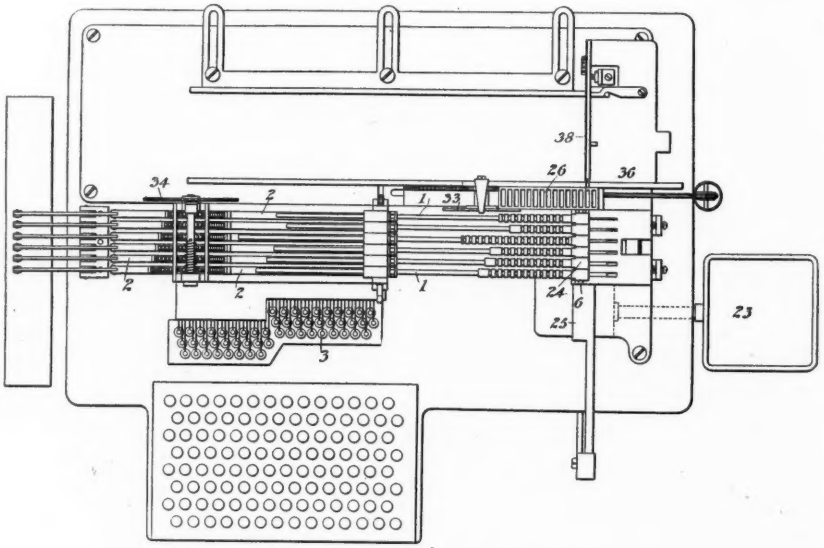


FIG. 2.—PLAN VIEW.

best traced in Fig. 3, which is a diagram of the circuits.

It will be observed that whenever a key 11 is depressed it closes the circuits of three electromagnets. Of these the magnet 4 releases a carrier 2, and the magnet 3 lifts a stop pin to arrest the carrier when the proper matrix reaches the mould. The other magnet 12 is carried on a working frame which is held by a spring against the levers 13, to which the springs 5 are connected. The armature 14 is attached to the contact-arm 15, and is held clear of its magnet by a plate 16, secured to this arm, which rests against the levers 13. Every time a lever moves forward on release of a carrier the frame is swung with it, but when the carrier is suddenly arrested by a stop pin the frame is momentarily carried on by its momentum, permitting the magnet to attract its armature, and thus close the circuit of magnet 17. The armature of this magnet withdraws the stop bar 18 from a notch in the cam 19 and at the same time makes a contact at 20, which closes the circuit of the magnet 21 on the driving pulley. Energy is supplied by this magnet through contact springs acting on the ring 22, Fig. 1. The armature of the magnet 11 is linked to a pair of toggle levers acting on a friction band carried by the cam shaft. The cam shaft is thus instantly set in motion and continues until it has completed one rotation, when the stop bar 18 again enters the notch and opens the switch 20.

When the cam shaft is set in motion the cam slide 9 is drawn down, raising the injector 7. The latter operates in a chamber supplied with molten type metal from the reservoir 23. Connected to each injector by suitable levers is a guide 24, which draws down the matrix bar and clamps it to the mould while the injector forces in the molten metal. The type metal hardens immediately and the sides of the mould are withdrawn, permitting the ejector 25 to slide the type out of the mould into a chamber of the word magazine 26. Before the cam shaft comes to rest the various parts are returned to their original positions, the matrix bar being returned by the cam 27. The same operation takes place every time a character key is touched.

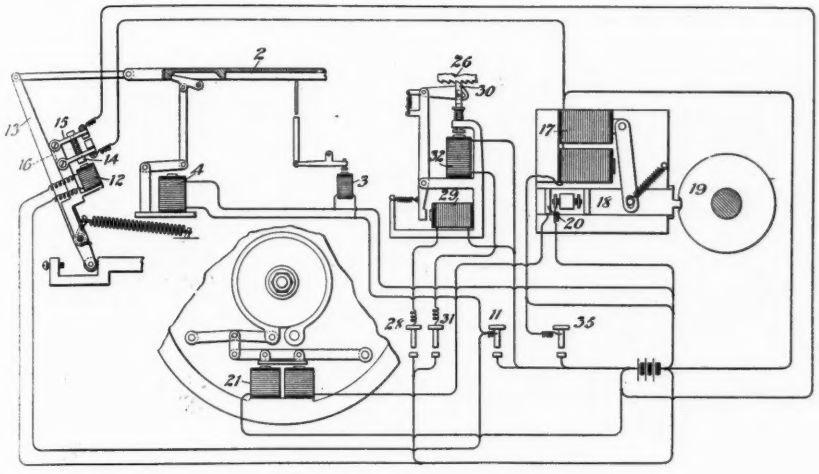
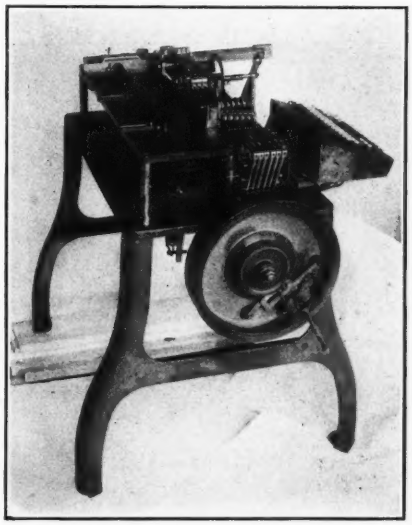


FIG. 3.—DIAGRAM OF CIRCUITS.

When a complete word has been assembled in the word magazine, the latter is moved to present a new chamber to the mould in which the next word is assembled. This is done by touching the key 28, which closes the circuit of magnet 29. A pawl attached to the armature of this magnet and engaging a ratchet formed on the bottom of the word magazine is thus operated to move the magazine forward, where it is held by a detent 30. When all the words of the line have been assembled the key 31 is touched, causing the magnet 32 to be energized. The latter then withdraws both the detent and the pawl, permitting the magazine to slide back to its original position. A comparison of the dials 33 and 34 shows the operator how many spaces are required and how thick they must be to completely fill out or justify the line. The required space key is now struck and the machine operates as before, except that the throw of the ejector is increased, so that as each type is cast it is pushed through to the galley carrying with it the type assembled in the word magazine. The magazine is, of course, moved forward after each space is cast so as to bring the word chambers successively in the path of the ejector. To move the last word into the line the key 35 is struck, which closes the circuit of magnet 17 without energizing any of the other magnets. Thus the cam shaft is set in motion and the ejector operates while the rest of the machine lies idle. As the last word enters the galley a latch is sprung which connects the block 36 with the cam 37. The latter lowers a fence 38 and moves the assembled line out of the path of the next line to be composed.



GENERAL VIEW OF TYPE-SETTING AND CASTING MACHINE.

It will be observed that the operation of the machine is simple and direct. The free use of electricity has done away with the multiplicity of rods and levers necessary in other machines. An important feature of the machine is the fact that the matrices are formed on bars instead of having separate pieces for each matrix.

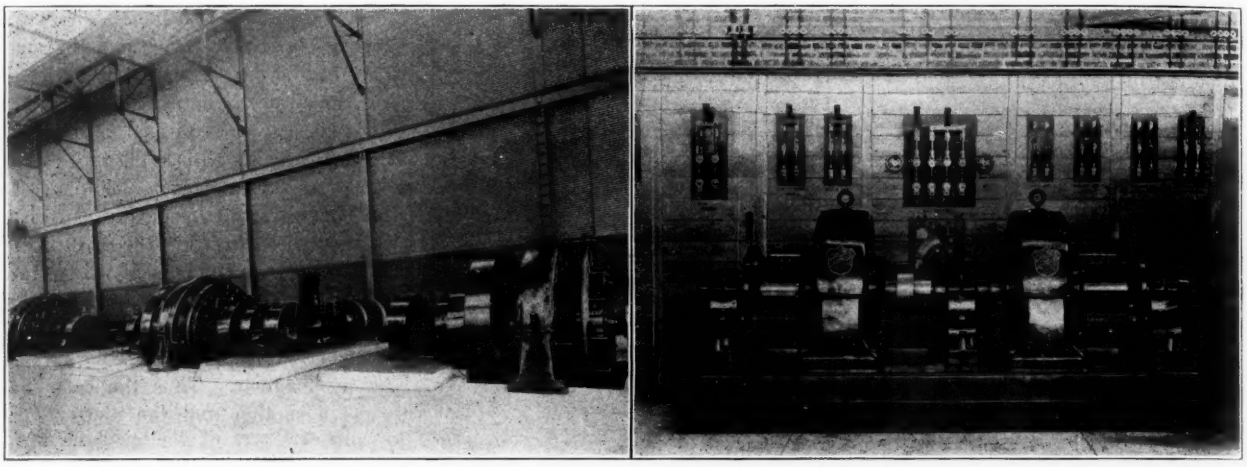
The Electrical Trades Exposition Company.

At a meeting of the executive committee of the Electrical Trades Exposition Company, held in Chicago, Ill., Friday, February 16, it was decided to effect a permanent organization to continue the management of the company and to take up immediately the work of preparation for the second annual electrical show, to be held January 14-26, 1907.

It was decided to abolish the title of general manager, and to substitute for it the title of managing director. An executive committee was appointed, consisting of Messrs. E. B. Overshiner, chairman; Charles E. Gregory and Stewart Spalding. Homer E. Niesz was appointed managing director. It is announced that over one-half of the floor space has already been applied for for the next show. It is the purpose of the management to take applications for the remaining space at once, and the allotment will be made at a date to be announced later.

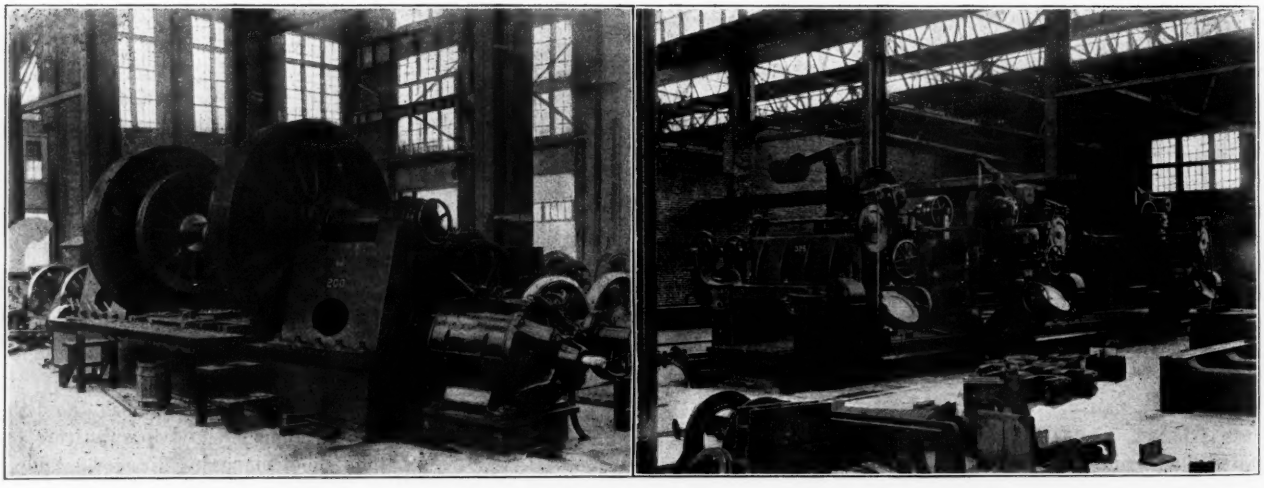
Electrical Equipment of the L. & N. R. R. South Louisville Shops.

In the new shops of the Louisville & Nashville Railroad Company at South Louisville, Ky., electricity has been applied to manufacturing purposes in a manner to interest the engineers by the eminently practical results produced. A transfer table, having a bridge 100 feet long and a transverse travel of 1,050 feet, is the centre about which the buildings are grouped, and serves as the connecting link to bind the various departments together. The bridge is operated by a railway motor capable of driving it at a speed of twelve miles per hour. By means of sliding clutches the motor may be disconnected from the bridge drive and connected to a drum to pull coaches and locomotives onto and off the bridge.



ENGINE AND GENERATOR EQUIPMENT AND MULTI-VOLTAGE ARRANGEMENT, LOUISVILLE & NASHVILLE RAILWAY SHOPS, LOUISVILLE, KY.

Along the north side of the transfer table lies the largest building of the group, having a length of 1,000 feet and including under one roof the boiler shop, the general machine shop and the erecting shop. The south bay of this building is divided into forty sections and every section has a track connecting with the transfer table. Eleven of these sections are in the boiler shop, which is separated from the erecting shop by a brick wall twelve feet high. The erecting floor is covered by a 100-ton crane provided with two trolleys and capable of carrying the largest-sized locomotives from any part of the erecting shop over the wall into the boiler shop. A ten-ton crane on a lower runway serves to carry small parts. These traveling cranes, of which there are eleven in all, are motor driven, the cranes being of the Niles-Bement-Pond Company's make.



MOTOR-DRIVEN LATHES AND SLOTTERS, LOUISVILLE & NASHVILLE RAILWAY SHOPS, LOUISVILLE, KY.

In the machine shop, however, the most interesting applications of electric drive are found. Near the middle of the shop is a switchboard controlling the various local feeders and connecting them to the mains running to the power-house. Near the switchboard is located a Bullock three-wire multiple-voltage balancer, which divides the 240 volts supplied by the mains into 100 and 140-volt circuits. A third wire, in addition to the generator main, serves to supply three different voltages, viz., 100, 140 and 240 volts, to the motors driving tools, which it is desired to operate at variable speeds. These different voltages are applied successively to the motor armatures by means of Bullock type "Y" controllers, and intermediate speeds and speeds above the normal at 240 volts are obtained by the use of shunt-field resistance.

To the north of the machine shop lie the forge shop and the wheel shop. In the forge shop motors are used where possible, but, as nothing has been done thus far to replace steam hammers, the number of motors is not very large. In the wheel shop the machine tools are all of a constant-speed type and are belted to countershafting. The whole shop is driven by a Bullock sixty-horse-power type "H" motor.

To the north of the wheel shop lies the foundry and electricity is used for all pur-

poses to which it is applicable. The drop for breaking the scrap, the blowers for the cupolas, and the ventilating fans as well as the cranes, are all motor driven. The distance from the power-house to the foundry is so great that no other method of transmission could be considered.

Locomotive Assembling Department, Louisville & Nashville Railway.

Placed along the east side of the foundry is a runway supporting a traveling crane, and this runway passes along the side of the wheel shop, the end of the machine shop and extends as far as the transfer table. The crane bridge is forty feet long, thus giving excellent yard service to the various shops and affording a very satisfactory method of transporting material from one department to another.

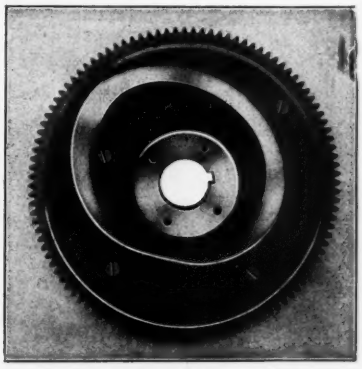
In the wood shop the tools are operated at constant speed and most of them are driven by belts from line shafts which are motor-driven.

The power-house is located at the south of the group of buildings where the handling of the fuel and ashes can be done most conveniently.

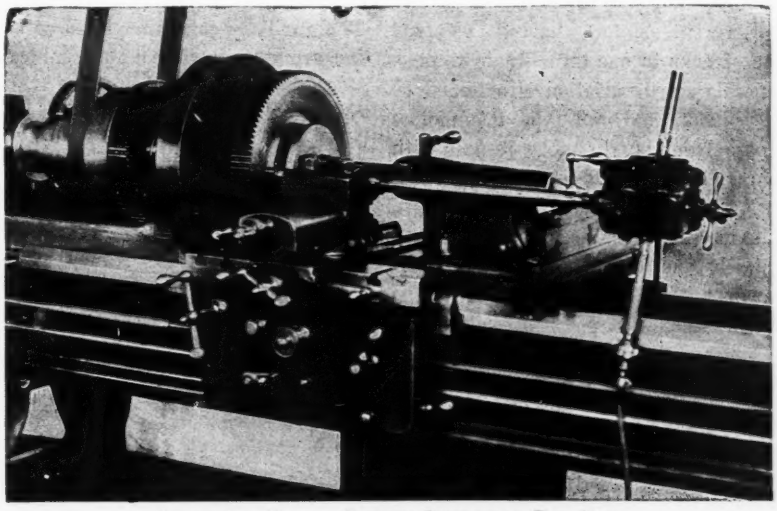
The equipment includes three 350-kilowatt 250-volt type "I" Bullock generators, direct-connected to cross-compound Buckeye engines running at 175 revolutions per minute. Steam at 125 pounds pressure is supplied by a battery of Stirling boilers provided with mechanical stokers. The coal elevator is motor-driven. In addition to the generators, the engine room contains a cross-compound, two-stage air compressor and a twelve by eighteen by twenty-four-inch fire pump. The switchboard, built by the Western Electric Company, is equipped with Weston flush-type instruments. All piping between engines and boilers is carried under the floor.

Cutting an Irregular Box Cam with the Aid of an Air Drill.

The accompanying illustrations show an irregular box cam and a novel method which was utilized in cutting out this piece of work. At one point the groove runs very close to the centre of the gear, while almost opposite to this point it runs close to the rim. The cam could not be cut with a single tool, it being absolutely necessary that the groove of the cam be parallel. The factory in which this cam was cut did not have a machine particularly adapted to the work, and an emergency method was devised, consisting of a block mounted on a slide engine lathe, in which a milling cutter was free to revolve. A master cam was attached to a mandrel with the gear in proper relation to it. As the lathe revolved slowly, the slide rest having been disconnected from the cross-feed screw, the milling cutter was kept in contact with the master cam by means of a weight fastened to the end of the cross-feed slide. The cutter arbor in contact with the master cam was the same diameter as the milling cutter used. This ensured an absolutely parallel slot. A "Little Giant" air drill, manufactured by the Chicago Pneumatic Tool Company, Chicago, Ill., was used for driving the cutter. The arrangement proved very satisfactory, as the speed could be controlled to a nicety, and the fixture was made at a minimum cost. There were no cumbersome belts nor other complicated mechanism necessary, and the set-up required no more time than an ordinary chucking job.



Irregular Box Cam, Cut on Lathe, with Cutter Driven with Air Drill.

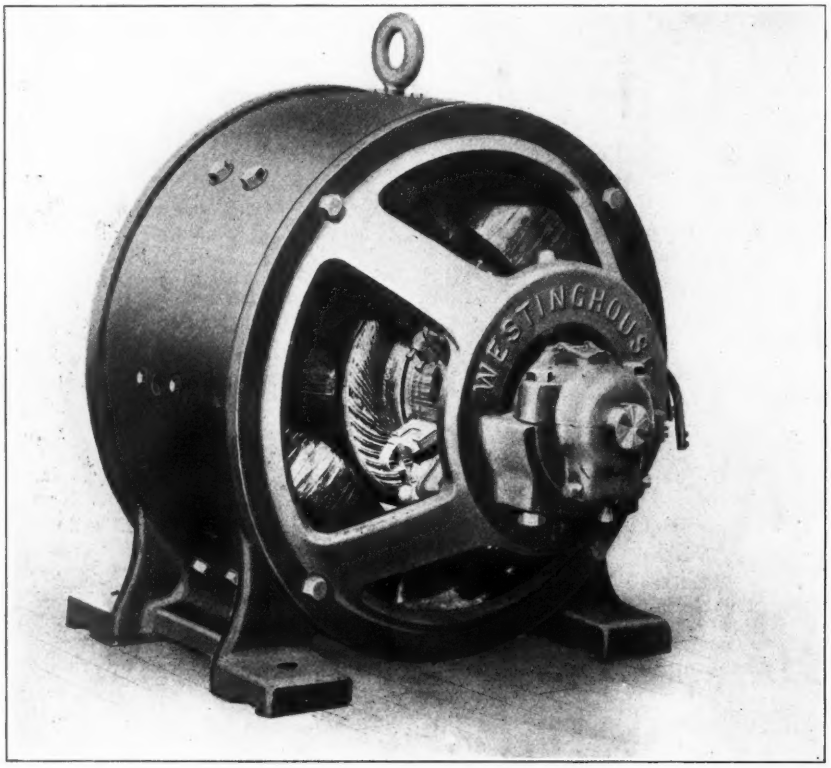


Lathe Set Up for Cutting Irregular Box Cam.

Mr. Henry J. Kimman, superintendent of the Cleveland plant of the Chicago Pneumatic Tool Company, supplied the illustrations and the explanation covering this work.

Westinghouse Auxiliary-Pole Motors, Direct Current.

In many classes of work a wide speed variation is required, and to meet the demands of such service the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., has developed a line of direct-current motors having a speed range of four to one on a single voltage. This wide speed variation is obtained by field control, and the type SA motors compare favorably in every respect with the best direct-current constant-speed machines.



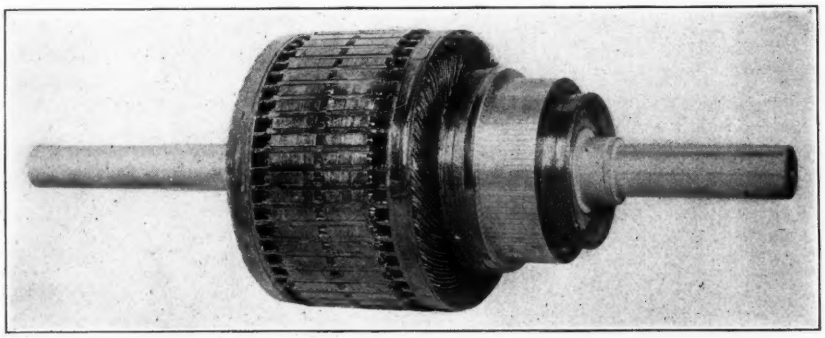
WESTINGHOUSE AUXILIARY-POLE MOTOR.

The new motors are exactly similar mechanically and electrically to the Westinghouse type S motors, except for the addition of auxiliary poles and coils. These are introduced in order to control the field form during the variation of field strength necessary to obtain so wide a range of speed. The cast-steel poles with machine-formed coils are placed midway between the main poles and securely bolted to the frame. The construction is very simple and introduces no complications whatever, nor does it make difficult the removal of the main poles and field coils, as is evidenced by the fact that an auxiliary pole and coil can easily be taken out, without in any way disturbing the main field winding, by simply disconnecting the coil connections, withdrawing the bolts which hold the pole to the frame and sliding the pole and coil out parallel to the shaft.

The auxiliary field winding is connected in series with the armature and therefore produces a magnetizing effect which is proportional to the armature current. The auxiliary coils are placed as close to the armature surface as mechanical considerations will permit and their turns are concentrated at that point. This arrangement adds materially to the performance of the motor, as it applies the corrective influence of the auxiliary winding directly at the points where the distorting effect of the armature current is strongest. This arrangement, the makers claim, is much more effective than the distribution of the ampere-turns along the length of the auxiliary poles. The magnetic field of the auxiliary winding acts in direct opposition to that produced by the armature current. The resultant field is made up of three components—that due to the shunt winding, that due to armature reaction and that due to the auxiliary windings. The field distortion usually produced by armature reaction is therefore overcome and the shape of the magnetic field at the point of commutation is maintained as formed by the main poles, and good commutation is made possible over a wide range of speed.

Type SA motors are shunt wound, which gives a definite speed for each point of the controller, which is nearly constant for all loads. Heavy overloads may be momentarily developed without injurious sparking. The motors are reversible without danger and without readjustment of the brushes, and, as the armature and auxiliary windings are connected permanently in series, it is only necessary to change the external armature connections to reverse the directions of rotation.

These motors develop their full rated output throughout their entire range of speed. They will carry full rated load at any speed within their range for six hours with a temperature rise not exceeding forty degrees centigrade in armature and field, and not exceeding forty-five degrees centigrade on the commutator, as measured by thermometer. At all loads and all speeds commutation is excellent, and an overload of twenty-five per cent may be carried for one hour without injurious sparking. All motors are thoroughly ventilated, running cool and at a uniform temperature. Their efficiency is high and their speed regulation practically exact. With the exceptions noted, type SA motors are mechanically identical with the type S, and corresponding parts are interchangeable.



ARMATURE OF WESTINGHOUSE AUXILIARY-POLE MOTOR.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

REORGANIZATION OF TEXAS INTERURBAN RAILWAY COMPANY—The Houston-Galveston Electric Interurban Company has been reorganized, and the directorate authorized to change the name to the Houston-Galveston Traction Company. The new board of directors elected is as follows: J. O. Ross, O. T. Holt, H. C. House, J. S. Rice, F. L. Dana, W. L. Scott, Hyman Levy, W. J. Moore and C. E. Barrett.

INDEPENDENT TELEPHONE COMPANY MAKES APPLICATION FOR FRANCHISE IN CHICAGO, ILL.—The Wapaul Electric Company has made application to Mayor Dunne, of Chicago, Ill., for a telephone franchise. The terms include a rate of $75 a year for unlimited service. The city is also offered the privilege of buying the company's plant after twenty years, at a price which will be appraised at that time.

SOUTH AMERICAN POWER COMPANY ORDERS EQUIPMENT—The Rio Janeiro Tramway, Light and Power Company has placed orders in New York for part of the equipment of a 100,000-horse-power electric plant to utilize water power eighty-five miles from the city. Interests identified with the Havana Electric Company, the Mexican Light and Power Company and the Sao Paulo Tramway Company control the Rio Janeiro company. Among these are William L. Bull, Sir William Van Horne and F. S. Pearson.

THE PENNSYLVANIA RAILROAD POWER-HOUSE—Plans have been filed for an electric power plant for the terminal station of the Pennsylvania, New York & Long Island Railroad tunnel, which is being built opposite the passenger terminal on the south side of Thirty-first street, extending from Seventh to Eighth avenue, New York city. It is to be of granite to match the depot, with a facade ornamented with pilasters, and will be three and four stories high, with a basement, cellar and subcellar. It will have a frontage on the street of 161.4 feet, and a depth of ninety-eight feet. The apparatus will be erected on separate floors, and the cost is estimated at $300,000.

BELL TELEPHONE COMPANY, OF PHILADELPHIA—At the annual meeting of the Bell Telephone Company, of Philadelphia (Pa.), the capital stock was increased to $30,000,000. New stock will be issued to the extent of $14,000,000, in the shape of 280,000 shares of the par value of $50 each. The old board of directors and officers were reelected, except that F. H. Bethell and Philip L. Spaulding will succeed the late Theodore Spencer, the former as vice-president, and the latter as general manager. The company has made one of the most remarkable showings in the manner of increasing the number of its subscribers of any company in the country, the increase for last year being nearly forty per cent.

NEW MEXICAN ELECTRIC LINE—The plans for the electric street railway system of Guadalajara, Mexico, to be built by La Electra, have been approved by Governor Ahumada. The plans were presented several months ago, and were prepared under the direction of C. A. Malau, chief of the construction department of the company. Rails are now being distributed, and preparations made for the immediate construction of track. Approximately ten miles of track can be laid in the city without disturbing the operation of the present mule-car system. The new system will take in a number of streets not now used. The system will consist of ten circuits within the city limits, and lines to the suburban towns of San Pedro and Zapopan.

TO DEVELOP TRENTON FALLS—The decision of the stockholders of the Utica Gas and Electric Company to increase the capital stock to $3,500,000 will make possible a number of contemplated improvements and extensions. It is the intention of the company to develop to their fullest capacity the water powers owned by it at Trenton Falls and Prospect, N. Y. A conservative estimate places the capacity of these falls at 22,000 horse-power. There is a fall in the West Canada creek of a little over 400 feet in a distance of three and one-half miles upstream from the Trenton Falls power-house of the company. The Trenton Falls station utilizes but 266 feet of this head. The company will locate a dam and power-house about a mile above the present development, and the balance of the 400-foot head will be utilized.

POWER PLANT STARTED AT UNION, S. C.—The first utilization of the electrical power plant of the Union Manufacturing and Power Company, at Neal's Shoals, was made at the works of the Buffalo Cotton Mills, Union, S. C., on February 7. The power plant is located on Broad river, fourteen miles east of Union. The Union Manufacturing and Power Company was organized three years ago with T. C. Duncan, president, capitalized at $500,000. Work on the dam, which is 980 feet long, was commenced the following April, but the whole plant was not completed until last October. The power company is closely allied with the Union Cotton Mills and the Buffalo Cotton Mills. It is expected that the Union Cotton Mills will be operated by electricity within a month. It is estimated that about 7,000 horse-power can be generated at Neal's Shoals. The cotton mills will utilize but a small portion of this, and an arrangement will probably be made to furnish the city with current, allowing it to distribute it to consumers in the town.

AN EXTENSIVE WATER POWER ORGANIZATION IN GEORGIA—A $3,000,000 electric power company has been formed at Columbus, Ga., and has taken over the following properties: North Highlands power plant and riparian rights of the Columbus Power Company, the property of the Chattahoochee Falls Power Company, of North Columbus, and the property of the Coweta Power Company, extending a number of miles along the Chattahoochee river in Harris and Muscogee counties. A total water power of 75,000 horse-power is afforded by the falls of the Chattahoochee river on the lands owned by the new company. The new company is temporarily designated as the Columbus Electric Company, but it is simply a holding company, and will turn over these properties to another company, the Columbus Power Company, petition for incorporation of which has been filled. The incorporators are the local representatives of a New England syndicate, represented by Stone & Webster, of Boston, Mass. The company will have a capital paid in of $1,850,000, and an authorized capital of $3,000,000. As fast as necessary the company will develop the water powers. A steam plant with a capacity of 3,000 horse-power will be built at once to supplement the North Highlands power plant. Plans for a dam across the river at Clapp's factory, developing 15,000 horse-power, will be prepared at once. A large paper mill and other industries will be built to utilize the new power.

CANADIAN BELL TELEPHONE COMPANY TO EXTEND SYSTEM—The management of the Canadian Bell Telephone Company has completed arrangements for the expenditure this year of nearly $2,000,000 in the carrying out of an extensive programme of general improvements to the system throughout the Dominion. The company is proceeding with the construction of an uptown exchange situated on Mountain street, north of St. Catherine street, Montreal. An order has been given for a new switchboard of the most modern type, which will cost over $200,000. Plans are being prepared for a new building in Westmount. A new switchboard will be required for this exchange, as the company contemplates changing over all the telephone apparatus in Montreal to the central energy system. In Toronto the growth of business will necessitate the construction of another large exchange in the northwest portion of the city. A block of land has been purchased for the purpose of building an exchange to accommodate 10,000 subscribers. Considerable extension to buildings and apparatus will be undertaken at Ottawa and Brantford. At Three Rivers a new building has been purchased to take care of the growth of business at that point. In connection with extensions to the long-distance service, the company contemplates erecting in Ontario and Quebec about 3,500 miles of long-distance wire lines, and about 250 miles of new pole lines. In the province of Manitoba, and in the northwest about 1,500 miles of new lines will be placed in position. A large amount of minor work will also be done.

NEW INCORPORATIONS.

ALBURGH, VT.—Alburgh Telephone Company. $2,000.

LINCOLN, NEB.—Farmers' Telephone Company. $2,400.

DES MOINES, IOWA—Klein Rural Telephone Company. $2,000.

MADISON, WIS.—Eagle Telephone Company. Increased to $20,000.

OCONOMOWOC, WIS.—Badger Telephone Company. Increased to $5,000.

HUDSON, WIS.—St. Croix Power Company. Increased to $250,000.

JACKSON, MICH.—Cambridge & Woodstock Telephone Company. $500.

DES MOINES, IOWA—The Iowa Transfer and Railway Company. $300,000.

LINCOLN, NEB.—The Page Telephone Company, Page, Holt county, Neb. $10,000.

BENTON HARBOR, MICH.—The Southern Michigan Light and Power Company. $1,000.

DAVENPORT, IOWA—Des Moines, Creston & Western Interurban Railway. $100,000.

COUNCIL BLUFFS, IOWA—Independent Telephone Company. Increased from $100,000 to $500,000.

WEBB CITY, MO.—Empire Electric Power and Supply Company, of Carthage. Increased to $25,000.

CRIPPLE CREEK, COL.—Empire Water and Power Company. To generate and sell electric power. $10,000.

DENVER, COL.—United Hydroelectric Company. $500,000. Incorporators: George E. Kimball, Jr., William L. Bush.

AUSTIN, TEX.—San Marcos-Luling Traction Company. $500,000. To build an electric road between San Marcos and Luling.

CLARIDON, OHIO—The Claridon Telephone Company. $5,000. Incorporators: A. A. McNish, H. D. Morgan and W. J. Wilmot.

SPRINGFIELD, ILL.—Southern Traction Company, East St. Louis. To construct a road from East St. Louis to Millstadt. $2,500.

MADISON, WIS.—The Ladysmith Lighting Company, Ladysmith. $25,000. Incorporators: C. A. Huffman, G. E. Newman and L. E. McGill.

GUTHRIE, OKLA.—The Dover & Columbia Telephone Company, of Columbia. Incorporators: A. E. Haughey, J. D. Crabtree and W. C. Ball.

LAURENS, S. C.—The Reedy River Power Company. $50,000. Directors: J. O. C. Fleming, J. H. Sullivan and N. B. Dial, all of Laurens.

HAMMONDSPORT, VA.—Hammondsport Telephone Company. $3,000. Officers: president, J. W. Scott; vice-president, M. A. Hoyt; secretary and treasurer, L. D. Masson.

HUTCHINSON, KAN.—Hutchinson Interurban Railway Company. $100,000. Incorporators: Emerson Carey, W. Y. Morgan, J. S. George, T. J. Templar and K. E. Sentney, of Hutchinson.

RICHMOND, VA.—Elkton & Shenandoah Mutual Telephone Company. $1,000. Incorporators: G. M. Harnsberger, president, Shenandoah; C. H. J. Blose, secretary and treasurer, Elkton.

COLUMBUS, OHIO—The Haskins Bell Telephone Company, of Haskins, Wood county. $10,000. Incorporators: H. A. Twining, L. A. Challen, H. J. Johnson, F. W. Heald and A. M. Wickham.

CLEVELAND, OHIO—The Lorain & West Virginia Railway Company, of Cleveland. $10,000. Incorporators: F. S. Whitcomb, W. R. Whiting, R. L. Denison, C. T. Brooks and Clarence E. Sanders.

GUTHRIE, OKLA.—Deer Creek & Lamont Telephone Company, of Woods county. $1,200. Incorporators: John Baker, of Lamont; S. R. Vincent and E. F. Webster, of Deer Creek, and B. H. Ritter, of Eddy.

NASHVILLE, TENN.—Home Telegraph Company. To build a telegraph line from Franklin to Goodlettsville. $10,000. Incorporators: R. E. Cooper, W. C. Polk, L. S. Miller, Louis Dupont and Luke Lea.

HARRISBURG, PA.—The Susquehanna Central Railway Company. To build 100 miles of road through Clearfield, Centre and Clinton counties. $1,000,000. James K. Garder, of Ridgeway, Elk county, president.

SALT LAKE CITY, UTAH—Idaho Light and Power Company. $30,000. Incorporators: C. F. Little, E. L. Henderson, M. H. Allen, all of Salt Lake City; H. Hodgson, of Culbertson, Mont., and C. G. McLaughlin, of Malad.

HARRISBURG, PA.—Standard Gas, Light, Heat and Power Company, Olyphant; $5,000. Taylor Gas, Light, Heat and Power Company, Taylor; $5,000. Union Gas, Light, Heat and Power Company, Dunmore; $5,000. Blakely Electric Company, Scranton; $5,000.

RISING SUN, IND.—The Salem Ridge Mutual Telephone Company, Rising Sun. $2,500. Directors: William A. Rockafellow, Charles Rice, George A. Woods, John A. Hamilton, H. Clay Miller, George H. Keeney, Albert Corson, William Hastings, Clifford W. Monroe.

WEATHERFORD, OKLA.—Northwestern Mutual Telephone Company. To build a telephone system throughout the counties of Custer, Dewey, Day, Woodward and Beaver. $3,000. Incorporators: W. S. Wood and W. A. Coddington, of Weatherford; Joseph Wolverton, of Indianapolis, Ind.

LITTLE ROCK, ARK.—The Ozark & St. Paul Telephone Company. To construct a telephone line in the northern part of Franklin county and southern part of Madison county. $5,000. Incorporators: C. B. Blaylock, Joseph Hill, S. Davis, J. A. Bateman, W. T. Bateman, H. G. Bristow, S. H. Davis and B. M. Welton.

NORWAY, ME.—Crockett Ridge & Millettville Telephone and Telegraph Company. Organized for the purpose of constructing, maintaining and operating telephone or telegraph lines in certain localities in Oxford county. $5,000. Officers: president, E. B. Tubbs, of Norway; treasurer, H. G. Dinsmore, of Norway.

ALBANY, N. Y.—The North Country Telephone and Telegraph Company. To carry on operations in the counties of Jefferson, Lewis, St. Lawrence and Oswego. $15,000. Directors: F. E. Rosbrook, M. J. Matty, C. E. Pail, Stephen Gould, F. G. Rosbrook and E. E. Ward, of Evans' Mills, and A. I. Rosbrook, of Carthage.

COLUMBUS, OHIO—The Columbus & Miami Valley Railway Company, of Xenia. To build an electric road to run from Columbus to Xenia, with a branch to Oregonia, passing through Franklin, Pickaway, Madison, Greene, Fayette, Clinton and Warren counties. $10,000. Incorporators: Gwynne Dennis, J. W. Dawson, Charles Follett, W. H. Thompson and J. W. Jones.

SPRINGFIELD, ILL.—Herrin & Carterville Railway. To be constructed from Herrin, Williamson county, southwesterly to Carterville, Williamson county, Illinois. $150,000. Incorporators and first board of directors: Chester M. Dawes, Chicago; Charles V. Carpenter, Downer's Grove, Ill.; J. A. Connell, John M. Dering, LaGrange, Ill.; Herbert Hasse, Western Springs, Ill.

ALBANY, N. Y.—The Dobbs Ferry Traction Company. To operate a street surface electric railway from Hastings to Dobbs Ferry, Westchester county. $20,000. Directors: Joseph G. Switzer, Mark J. Katz, Isaac M. Levy, John D. Mason, George T. Van Valkenburgh, Joseph L. Epstein, Henry Siegrist, Jr., Harry A. Mendelson and Thomas J. Snee, of New York city.

SPRINGFIELD, ILL.—Belvedere, DeKalb & Southern Railway Company. To be constructed from the northern line of McHenry county through McHenry, Boone, DeKalb, Kane, Kendall and Will counties, to Joliet. $1,500,000. Incorporators and first board of directors: W. H. Zimmerman, DeKalb; J. B. Huling, Chicago; J. D. Harvey, Geneva; J. C. Williams and Millard R. Powers, Chicago.

OLYMPIA, WASH.—The Spokane-Pend d'Oreille Rapid Transit Company, Limited. To construct and operate lines of street railway in Spokane and interurban lines following a general course from Spokane eastward through the Spokane valley to Lake Pend d'Oreille. $2,000,000. Incorporators: D. K. McDonald, J. Grier Long, W. S. McCrea, W. A. Hutchinson, J. C. Cunningham, Mark F. Mendenhall, Harry A. Rhodes, C. H. Reeves and F. W. Anderson.

TELEPHONE AND TELEGRAPH.

CONNERSVILLE, IND.—The Bell Telephone Company has arranged to rebuild its local plant, so as to increase the capacity to 1,000 telephones.

FORESTVILLE, N. Y.—The Hanover Telephone Company has been merged with the Interocean company and will shortly install a new exchange at Forestville.

ST. PETER, MINN.—Officials of the Cannon Valley Telephone Company are planning extensive improvements to be made to their system during the coming summer.

AMBLER, PA.—The Bell Telephone Company will build a new central office at Ambler. The switchboard to be installed by January, 1907, is designed to handle 2,000 lines, or about 4,500 subscribers.

WHEELING, W. VA.—The Belmont Telephone Company, of Bridgeport, has reelected officers as follows: president, J. C. Heinlein; vice-president, Henry Schmulbach; secretary, W. I. Steer; treasurer, J. C. Dent; general manager, A. H. Doudna.

VALMEYER, ILL.—A telephone company has been organized with Henry Volhardt as president, and Dr. E. J. Lee, Jr., secretary. The lines of the company will connect with those of the Farmers' Fountain Telephone Company, of New Hanover.

EVANSVILLE, IND.—The Citizens' Telephone Company, which recently filed articles of incorporation at Indianapolis, will erect an exchange at Evansville, costing between $300,000 and $400,000. The company will connect with all independent lines in southern Indiana.

KUTZTOWN, PA.—An independent telephone line is to be extended from Kutztown early next spring or as soon as the weather permits. It will be connected with the Consolidated company's line. From Kutztown the line will touch Deitrich's Mill, Liscum, Krumsville, Klinesville, Greenawalt's Station and Kempton.

PLATTSMOUTH, NEB.—At the annual meeting of the Plattsmouth Telephone Company the following officers and directors were elected: president, T. E. Parmele; vice-president, C. C. Parmele; secretary, J. N. Wise; general manager and treasurer, T. H. Pollock; directors, T. E. Parmele, C. C. Parmele, T. H. Pollock, C. H. Smith, Edwin Jeary, J. H. Davis, Dr. J. M. Neeley, D. J. Pitman and H. F. Swanback. During 1905 the business of the company increased fifty per cent over the previous year.

LOS ANGELES, CAL.—The Sunset Telephone and Telegraph Company has filed its annual report. The statement shows that the company for the year ending January 1, 1906, received from rent of telephones within the city of Los Angeles $535,772; for furnishing telephone service and making of connections, other than rentals, $5,981, and from outside sources, $74,532. The total expenditures for the year are given as $592,383.56, and the tangible assets within the city $943,744. According to the statement the company has 25,336 telephones in service within the city limits, and 200 miles of poles carrying wires and cross-arms.

OMAHA, NEB.—The following officers were elected by the Nebraska Telephone Company at its annual meeting. C. E. Yost, president; H. Vance Lane, vice-president; E. M. Morsman, secretary and treasurer; W. A. Pixley, auditor; Lawrence Brinker, assistant treasurer. The company is contemplating the expenditure of over $1,000,000 this year for the extension and betterment of the plant. The expenditures comprise $23,000 for underground conduits, $83,000 for underground cables, $250,000 for substations, $220,000 for toll lines, $96,000 for real estate and buildings, and $155,000 for farm lines, making a total of over $1,000,000.

BURLINGTON, N. J.—At a special master's sale all property of the Standard Telephone Company, operating in Burlington, was disposed of to the highest bidder to satisfy claims held against the telephone company by the Burlington City Loan and Trust Company. The property comprised all lines, exchanges, cables and other fixtures and appliances of the Standard line. It was bid in by Charles F. Miller, of Lancaster, Pa., attorney for the bondholders of the telephone company, at the very low figure of $2,500. The purchasers are to assume all present debts of the Standard company. It is reported that this line is to be merged with another concern.

ELECTRIC RAILWAYS.

CLEVELAND, OHIO—The Northern Ohio Traction and Light Company will build an electric line from Barberton to Seville, Medina county.

PITTSBURG, PA.—A charter for the Mawhinney Street Railway Company has been granted. This line is to be used in connection with the proposed East End tunnels.

HONESDALE, PA.—The stock for the new trolley road between Hawley and Seeleyville has been sold, and everything will be in readiness to begin work about April 1.

ELMIRA, N. Y.—The state railroad commission has granted permission to the Elmira, Corning & Waverly Street Car Company to construct, maintain and operate an electric line between Corning and Waverly, passing through Elmira.

TACOMA, WASH.—An extension to May 5, 1906, has been granted by the county commissioners to Fred J. Chamberlain in which to begin work on the new electric line between Tacoma and Puyallup, under the franchise granted him in August last.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company has filed plans with the building department for a brick substation building at Richmond Hill. The new structure is to be thirty-six feet front and rear by seventy-five feet in depth, and is to cost $20,000.

ALBANY, N. Y.—The state board of railroad commissioners has approved the petition of the Union Traction Company for leave to change its name and to assume the corporate name Batavia, Medina & Ontario Railroad Company. The company proposes to construct a street surface railroad from Batavia, Genesee county, northerly, through the village of Medina, Orleans county, to Olcott, Niagara county, on the shore of lake Ontario.

MINNEAPOLIS, MINN.—The Fort Dodge street railway has been sold to the Newton & Northwestern Railroad Company for $70,000. It will become part of an interurban electric system, uniting Boone, Ames and Des Moines. The company expects to haul freight by steam and passengers by electricity in two hours and thirty minutes between Fort Dodge and Des Moines, eighty miles. The connecting link crossing the Des Moines river is being surveyed.

FOREST GROVE, ORE.—At a meeting of the stockholders of the Forest Grove Transportation Company the following board of directors was elected: Senator E. W. Haines, George G. Hancock, F. A. Watrous, George F. Naylor, J. E. Loomis and Judge W. H. Hollis. The Forest Grove Transportation Company has been capitalized at $10,000, and proposes to build an electric line on the principal business streets from the depot to the business centre of the town. The road is to be in operation by May 1.

MOBILE, ALA.—Harry Pillans has deposited with the city clerk a certified check for $5,000 as an earnest of an intention on the part of himself and associates to construct electric car lines over certain streets of Mobile, for which they have been voted a franchise. It is said that Mr. Pillans is backed by Captain J. T. Jones, of Gulfport, Miss., and that a part of the plan is to extend the line along the gulf coast, connecting Mobile and New Orleans. Work must begin within six months, and the proposed line completed within two years.

INDIANAPOLIS, IND.—The Capital Circuit Traction Company has been incorporated under the laws of the state of Indiana with a capital of $100,000. The road will pass through the seven counties surrounding and adjoining Marion county, and will touch the following-named county seats: Greenfield, Noblesville, Lebanon, Danville, Martinsville, Franklin and Shelbyville, opening up a comparatively undeveloped territory. The incorporators are J. N. Crabb, J. A. Shafer, C. E. Worth, C. E. Averill, all of Indianapolis; C. J. Richman, Greenfield; A. R. Tucker, Noblesville; Frank Daily, Lebanon; J. W. Trotter, Danville; S. M. Guthridge, Martinsville; B. P. Brown, Franklin; Louis Holtman, Shelbyville. Officers have been elected as follows: president, J. N. Crabb; vice-president, J. W. Trotter; secretary and treasurer, C. E. Worth; chief engineer, J. A. Shafer; general counsel, C. E. Averill. The company is now securing franchises and rights of way and will soon begin the work of surveying the route.

ELECTRIC LIGHTING.

HUBBARD CITY, TEX.—The Hubbard City council has granted an electric light and ice plant franchise to W. A. Bass.

ROCKVILLE, CT.—The Rockville Gas and Electric Company is erecting a substation at the rear of its electric plant.

WINDSOR, ILL.—Thomas Lefforgee, of Windsor, has been granted a franchise by the council for an electric light plant.

MOUNT CARMEL, PA.—The borough of Girardville has decided to close a five-year street lighting contract with the Frackville & Gilberton Light, Heat and Power Company.

RADFORD, VA.—The town of Christiansburg is now lighted by electricity, the current being supplied by a power-house at Grayson, on Little river, twelve miles distant.

RANIER, ORE.—The Ranier city council has granted a twenty-five-year franchise to W. P. Ely for an electric plant. Mr. Ely guaranteed to have the plant in operation in sixty days.

CHICKASHA, I. T.—At a special session of the Chickasha city council the electric light franchise held by Judge Holmes and associates, of Lincoln, Neb., was extended for a period of ten years.

CRESTON, IOWA—The members of the Creston city council have gone on record for municipal ownership by adopting a resolution to purchase the new electric light plant recently erected at Creston by a mutual company of business men.

BOYNE CITY, MICH.—The Boyne City Electric Light Company has closed a deal, whereby it secures three acres of land along the river front. The company will begin the erection of a new power plant early in April. Prominent Grand Rapids capitalists are behind this enterprise.

YORK, PA.—The North York council has awarded the contracts for lighting the borough for the ensuing year to the Merchants' Electric Light, Heat and Power Company. The cost of each light will be eleven cents per night, or three cents less than under the present contract.

LOGAN, IOWA—The Logan Electric Light Company, by a deed filed with the county recorder, has transferred the Logan electric light plant and the milling property on the banks of the Boyer to J. A. Felthouse, of St. Paul. The consideration was $85,000 and several tracts of Canada land.

NOBLESVILLE, IND.—The S. M. Smith electric light plant has been sold to a party of Kokomo capitalists, the consideration being $22,500. The sale carries with it a ten-year contract to light the streets of Noblesville at $70 a light per annum. The new company will remodel the plant throughout.

ALBANY, N. Y.—The Hudson River Electric Company has elected Charles H. Peddrick, Jr., James M. Seay, Louis A. Jones and T. A. Tenney directors. The directors elected Mr. Peddrick president; H. B. Austin, vice-president; E. J. West, secretary and assistant treasurer; Eben H. Gay, treasurer.

CUMBERLAND, MD.—A move is on foot to harness Swallow falls on the Yough river, nine miles from Oakland. The purpose is to furnish power for an electric light plant and other manufactories that may be established along the Oakland & Confluence Railroad. It is said the project will be started within a year.

WAYNESBORO, PA.—The stockholders of the Waynesboro Electric Light and Power Company have elected the following directors: George B. Beaver, J. J. Oller, H. B. McNulty, D. M. Wertz, J. W. Warehime, E. C. Stull and M. E. Sollenberger. George B. Beaver was elected president and H. B. McNulty, secretary.

LOCKPORT, N. Y.—The new large block power rates of the Lockport Gas and Electric Light Company have gone into effect. Manufacturers who will contract to use power the year around and twenty-four hours a day and who formerly paid $30 per horse-power on a sliding scale, can now obtain the same power at prices ranging from $20 to $22 a horse-power.

ALBANY, N. Y.—The board of contract and supply of Albany has awarded a contract for the lighting of the city for the next five years, beginning June 21 next, the date of the expiration of the present contract. The bid accepted places the price at twenty-seven cents per lamp per day, or $98.55 per lamp per year. Those figures include repairs, cleaning and replacing globes.

BAKER CITY, ORE.—In the Cable Cove camp, fifteen or twenty miles out of Sumpter, and about thirty miles west of Baker City, it has been decided by the management of the Ophir mine to install a hydroelectric power plant on Baldy lake to furnish lights and power for properties of Wheeler & Company, the New York owners of the Ophir and Sheridan groups, and for other mines.

SAN DIEGO, CAL.—A contract for the purchase of the Brawley Town company property, including the local plant and franchises of the Imperial Light, Water and Power Company, has been drawn, the sum of $60,000 to be paid within five years. The purchaser is the Brawley Improvement Company. This sale is the culmination of an effort to secure control of the property by the people of the town.

DUQUOIN, ILL.—The Duquoin city council has granted a franchise for an electric light and power plant to Dr. T. B. Reagin and James Forester, who will construct an independent system. Work on the plant will begin at once. It is thought that St. Louis capitalists are interested in the project, it being spoken of in connection with a proposed electric railway to connect Duquoin with surrounding towns and to carry coal from the mines.

BAKER CITY, ORE.—The Rock Creek hydroelectric plant of the Baker Light and Power Company, situated in the mountains, eighteen miles west of Baker City, is now supplying power and lights to several mines and to Baker City. As an adjunct to this plant the company is completing an auxiliary steam plant at South Baker City, which will furnish power and lights for the city in case of necessity, and which will be used for lighting Baker City.

WELLSVILLE, OHIO—Plans have been completed by the East Liverpool Traction and Light Company to build an electric line from Chester, W. Va., to Wellsburg, W. Va., opposite Brilliant, Ohio. The new line is being surveyed. This road will give through electric traffic from Wheeling, W. Va., to the West Virginia state line, a distance of over sixty miles. The company is an Ohio corporation and the new road is being financed in the east. Construction work is to begin in the spring.

EASTON, MD.—A deal has been closed in Philadelphia between the Philadelphia capitalists who own the Easton Gas and Electric Light Company and Louis Dalmas, owner of the Salisbury Electric Light Company, whereby Mr. Dalmas secures control of the Easton company. It is understood that the amount involved was between $25,000 and $40,000. By the purchase of the Easton plant Mr. Dalmas now owns or controls six electric lighting and gas plants, two in New Jersey, two in Pennsylvania and two in Maryland.

WHEELING, W. VA.—At the annual meeting of the stockholders of the Ohio Valley Electric Light and Power Company, the old directors were reelected as follows: William C. Handlan, John F. Frasher, W. H. Snyder, C. P. Kinney and S. E. Dorsey. The meeting of the directors followed immediately and the following officers were chosen for the year: president, W. C. Handlan; general manager, John F. Frasher; secretary-treasurer, William H. Snyder. Several routine business matters were transacted. It is understood that the stockholders authorized improvements and additions to the plant entailing the expenditure of a large sum, which will be commenced early in the spring. The Ohio Valley company absorbed the Home Electric Light Company and the Benwood & McMechen Electric Light Company several months ago.

HAGERSTOWN, MD.—The Martinsburg Power Company has applied to the court of Jefferson county for a franchise giving it the privilege of erecting poles and stringing wires for the purpose of conducting electric current along certain public roads. The company purposes building lines from Dam No. 4 to Shepherdstown, and thence to Martinsburg, and also to run a branch circuit from Shepherdstown to Kearneysville. The Martinsburg Power Company operates the electric power plant at Dam No. 5, from which power and light are supplied to Martinsburg. It is now in negotiation for property at Dam No. 4, about four miles above Shepherdstown, where it purposes erecting another plant to utilize the enormous water power that can be developed there. It is the intention of the company to furnish electric lights and power for Shepherdstown and also to convey power to the big quarries at Kearneysville. The company will later apply for a franchise at Shepherdstown.

PERSONAL MENTION.

MR. JOHN C. REILLY has been elected a director of the New York & New Jersey Telephone Company, succeeding Waldron Hoppins.

MR. A. LADD COLBY announces the opening of an office at 447 Central Park West, New York city, as consulting engineer, inspecting engineer, and iron and steel metallurgist.

MR. P. A. BERTRAND, manager of the Springfield (Mo.) Gas and Electric Company, has been appointed manager of the Jefferson City (Mo.) Light, Heat and Power Company. Mr. Bertrand is succeeded at Springfield by W. A. Bixby, of Quincy, Ill.

MR. R. W. JUDD has resigned as treasurer of the Cuyahoga Telephone Company, Cleveland, Ohio. It is also announced that F. W. Dickson, president of the company, has tendered his resignation. Mr. Judd is to go with the Guardian Savings and Trust Company, and it is announced that Mr. Dickson is to become local manager for the brokerage firm of A. O. Brown & Company.

MR. E. J. KULAS, secretary and general manager of the Brilliant Electric Company, Cleveland, Ohio, is about to make a trip through the western cities for the placing of agencies in several of the important centres for the Brilliant "tipped" and "tipless" lamps. The success accomplished during the last ninety days through the eastern agencies for these lamps is reported by the Brilliant Electric Company to exceed expectations, and in consequence Mr. Kulas will immediately extend the sales organization through the agency system throughout the West.

OBITUARY NOTICES.

MR. HENRY RUSTIN, a well-known electrical engineer and lighting expert, died at his home in Florence, Neb., on February 27, of tuberculosis. Mr. Rustin was born in Omaha, Neb., September 4, 1865. He was graduated from the Sheffield Scientific School of Yale University in 1886 in electrical and mechanical engineering. In 1898 he installed the electrical plant and the street railway in Omaha, and was in charge of all the lighting of the Omaha Exposition. In 1901 he was placed in charge of the illumination for the Pan-American Exposition at Buffalo, N. Y., the lighting of which was one of the striking features. In 1903 he was retained as lighting expert for the Louisiana Purchase Exposition at St. Louis, Mo. Mr. Rustin was a member of the American Institute of Electrical Engineers and the Engineers' Club, of St. Louis. He was married in 1894, and his wife survives him.

PROFESSOR SAMUEL PIERPONT LANGLEY, secretary of the Smithsonian Institution, Washington, D. C., died at Aiken, S. C., on February 27, the cause being paralysis. Professor Langley was born in Roxbury, near Boston, Mass., in 1834. After receiving a high school education he practiced architecture and civil engineering and became assistant at Harvard Observatory, a position he resigned shortly to become assistant professor of mathematics at the United States Naval Academy. His interest in astronomy brought him the appointment as director of the Allegheny Observatory at the Western University of Pennsylvania in 1867, a position he retained for twenty years. During this time he founded the system of railway time service from observatories, which has since become general, and devised a number of scientific instruments, among these being the bolometer. His study of solar physics led to a number of important discoveries. He carried out many researches in other lines of physics, notable among these being his experiments in mechanical flight. In 1887 he was appointed secretary of the Smithsonian Institution. He received degrees from Oxford, Cambridge, Harvard, Princeton, Yale and other universities. He also was awarded a large number of medals for scientific research, and was the author of many scientific treatises. Professor Langley was unmarried.

NEW PUBLICATIONS.

THE JUNGFRAU TUNNEL AND ELECTRIC RAILWAY—M. G. de Fooz has republished from the *Revue des Questions Scientifiques* (Paris) his study of "Le Tunnel et le Chemin de Fer Electrique de la Jungfrau."

MECHANICAL COAL CUTTING—The North of England Institute of Mining and Mechanical Engineers has published a report of the committee upon mechanical coal cutting. This particular report deals with heading machines, and describes the various types employed, including a number of electrical devices.

IOWA ELECTRICAL ASSOCIATION—The proceedings of the fifth annual convention of the Iowa Electrical Association, which was held at Dubuque, Iowa, April 19 and 20, 1905, have been published. These contain a number of interesting papers.

TELEPHONE SYSTEMS IN CANADA—Report No. 37 of the select committee appointed to enquire into the various telephone systems in operation in Canada and elsewhere has been issued. It contains a large number of reports on systems in Europe, Australia, the United States, New Zealand, Egypt, South Africa and elsewhere.

ELECTRICAL SECURITIES.

There has been considerable speculative contraction in speculation and irregular movements in prices during the last few weeks. There are so many small factors in the situation that it is difficult to suggest any as being of immediate importance. Certainly the attitude of the federal government with regard to the railroad rate-question and the drastic measures which have been introduced in both the national and state legislatures in restraint of large corporations will, if they become laws, remove from the field of investment and speculation a source of considerable magnitude. Commission-house dullness reflects the attitude of the buying public. In fact, it has been said that if it were not for the general national prosperity offering a strong bulwark to the timorous there would have developed before this untoward and even panicky conditions.

New York:	*Closing.*
Brooklyn Rapid Transit	82¼
Consolidated Gas	160½
General Electric	170½
Interborough Rapid Transit	227
Kings County Electric	200
Manhattan Elevated	159
Metropolitan Street Railway	116
New York & New Jersey Telephone	155
Westinghouse Manufacturing Company	185

At the annual meeting of the New York & New Jersey Telephone Company, in Brooklyn, the former board of directors was reelected, with the exception of Waldron Hoppins. John C. Reilly takes his place on the board of directors; 136,062 shares were represented.

Boston:	*Closing.*
American Telephone and Telegraph	139¾
Edison Electric Illuminating	247
Massachusetts Electric	67
New England Telephone	135½
Western Telephone and Telegraph preferred	90

The instrument output of the American Telephone and Telegraph Company for the month of January follows: gross output, 176,607; returned, 63,224; net output, 113,383, as compared with 92,934 for January of 1905. The total now outstanding is 5,811,641.

Philadelphia:	*Closing.*
Electric Company of America	11¾
Electric Storage Battery common	79½
Electric Storage Battery preferred	79½
Philadelphia Electric	8⅛
Philadelphia Rapid Transit	30¾
United Gas Improvement	95¾
Chicago:	*Closing.*
Chicago Telephone	115
Chicago Edison Light	162
Metropolitan Elevated preferred	69½
National Carbon common	89
National Carbon preferred	115
Union Traction common	13
Union Traction preferred	40

Action on the Metropolitan Elevated dividend will probably be taken at the March meeting, when a dividend on a permanent basis will be declared. The company is arranging to sell bonds for improvements. It is reported that the annual statement will show 4 per cent on the preferred.

INDUSTRIAL ITEMS.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., in bulletin No. 29 illustrates and describes a full line of fusible hanger boards, taplets, panel cutouts, entrance switches and panel boxes.

THE NATIONAL WATER-WHEEL GOVERNOR COMPANY, Akron, Ohio, has issued a neat pamphlet descriptive of the new water-wheel governor. This governor was illustrated and described in a recent issue of the ELECTRICAL REVIEW.

DOSSERT & COMPANY, INCORPORATED, 242 West Forty-first street, New York city, have issued a new catalogue descriptive of their solderless wire and cable connectors. These connectors are made in various forms for all classes of service.

F. F. PROCTOR, proprietor of the Proctor circuit of theatres, announces a very extensive use of the telephone in connection with the ordering of seats in advance. Considerably the larger portion of the seats sold at the Proctor houses are ordered by this easy method of communication.

THE GRAY TELEPHONE PAY STATION COMPANY, Hartford, Ct., has issued a new catalogue descriptive of toll equipment for public and measured telephone service. This catalogue is very handsomely illustrated, and introduces several innovations in the line of telephone toll apparatus.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, has secured an order, through its Cleveland branch, for 850 squares of "J. M. asbestos roofing," from the Ohio Brass Company, to cover its rebuilt factories which were partially destroyed by fire last year at Mansfield, Ohio.

THE ABNER DOBLE COMPANY, San Francisco, Cal., is distributing a reprint from the transactions of the American Society of Civil Engineers, of a paper entitled "The Irrigation System of Ontario, California—Its Development and Cost," by F. E. Trask, with discussions by Arthur S. Hobby and the author.

THE SUMPTER TELEPHONE MANUFACTURING COMPANY, Sumpter, S. C., in bulletins No. 38 and No. 39 describes the Mason multi-discharge lightning arrester, and telephones and accessories, respectively. These bulletins are copiously illustrated, and the text accompanying each production is very complete.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces the issuance of United States patent No. 811,520 on January 30, 1906. This patent relates to horizontal-vertical types of steam engines, and was granted after long deliberation and controversy in the patent office on an application filed in August, 1890, by Edwin Reynolds, and assigned by him to the Allis-Chalmers Company.

THE WIRE AND TELEPHONE COMPANY OF AMERICA, Rome, N. Y., is distributing bulletin No. 100, descriptive of bare and insulated wire, telephone apparatus and telephone supplies. There is also an introductory to the contracting and engineering department of the company, and an announcement of the organization and the acquirement of the Electric Wire Works and the Empire Wire Company, both of Rome, N. Y.

THE SPRAGUE ELECTRIC COMPANY, New York city, has recently taken an order from the City Steam Laundry, Yonkers, N. Y., for an equipment comprising a generator, switchboard and six motors. The Sprague Electric Company has been very successful in the installation of motors for driving laundry machines. The large laundry machines in the new Knickerbocker Hotel, New York city, are to be driven by Sprague motors.

THE GOULD STORAGE BATTERY COMPANY, New York city, has opened a branch office in the Crossley Building, San Francisco, Cal., to meet the demands of its rapidly increasing business on the Pacific slope. The new branch is in charge of E. C. Sharpe, a prominent engineer, who was formerly connected with the John A. Roebling's Sons Company. The Chicago office, Rookery Building, has secured the services of R. H. Watson as an addition to its corps of engineers. Mr. Watson has been connected with the Gregory Electric Company. A new addition has also been made to the force of engineers in the main office of the company. Mr. Powers was, until recently, sales manager of the American Automatic Switch Company, and has likewise been associated with Thomas A. Edison and served in the engineering department of the New York Edison Company.

THE AUTOMATIC TIME STAMP COMPANY, 160 Congress street, Boston, Mass., announces that in the suit of the Calculagraph Company, of New York, versus John C. Wilson, brought under the patents of Hamilton and Abbott, to enjoin the Automatic Time Stamp Company from making or selling an instrument known as the timometer, used on telephone toll-line switchboards to record the time the toll line was in use by a customer, the United States Circuit Court of Appeals, in an opinion by Judge Colt, has reversed the decision of Judge Hale, of the United States District Court, and has remanded the case to the Circuit Court with directions to dismiss the bill of the Calculagraph Company with costs in the Circuit Court and in the Court of Appeals. Judge Hale had also found the defendant in contempt for making another machine for the same purpose, known as the duragraph, and the company announces that this decision of the Court of Appeals acts to void the latter finding also.

NEW MANUFACTURING AND CONSTRUCTING COMPANIES.

DOVER, DEL.—The Solar Arc Light Company, of New York city, has been incorporated with a capital of $500,000.

CORINTH, MISS.—The Alcorn Electric Company has been incorporated with a capital of $25,000. The incorporators are J. H. Jones, J. M. Boone and others.

COLUMBUS, OHIO.—The Telephone Signal Company, of Alliance, has been incorporated, with a capital of $15,000, by Binford T. Shreeve, Morris Taylor, William H. Shreeve, Orlin Shreeve and Arthur J. Shreeve.

ALBANY, N. Y.—The American Electric Welding Company, of New York city, has been incorporated with a capital of $500,000. The directors are Herman Kertscher, E. A. Kertscher, of New York, and F. H. Markthaller, of Elmira.

ROANOKE, VA.—Hunter, Brewer & Company, an electrical company capitalized at $10,000, has been incorporated to do a general electrical business. The officers are J. R. Heim, president, and G. D. Hunter, secretary and treasurer.

OMAHA, NEB.—The Wolfe-Lovett Electrical Company has filed articles of incorporation with a capital stock of $25,000. Of this amount $15,000 is paid up. The incorporators are L. W. Wolfe, L. C. Wolfe, Israel Lovett and E. R. Lovett.

BALTIMORE, MD.—Papers of incorporation have been granted the Durling Electric Company. The amount of capital stock is $10,000, divided into 200 shares of $50 each. The company will do a general electric business. The incorporators are William B. Turner, Joseph E. Henderson, Edward McIntyre, Charles R. Durling and Emory A. Craig.

ENGINEERING SOCIETY.

ST. LOUIS BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The St. Louis Branch of the American Institute of Electrical Engineers held a meeting on February 14 at the Engineers' Club. Mr. H. H. Humphrey presided. The minutes of the last meeting were read and approved, and the nominating committee appointed to name five members to serve as an executive committee for the ensuing year reported as follows: D. E. Webster, A. H. Timmerman, F. B. Adam, H. I. Finch and A. S. Langsdorf. No other nominations being announced, these five were declared elected. It was voted to meet at Lippe's Café on the evening of the March meeting, and after dinner to visit the Ashley street plant of the Union Electric Light and Power Company. Mr. J. H. Finney, on behalf of the Pittsburg Reduction Company, offered to meet the expenses of a smoker at the April meeting. This offer was accepted with thanks. The paper on "A Self-Exciting Alternator," read at the recent New York meeting, was presented, and this with the paper on "Power-Plant Economics" were discussed.